ASHLAND/NORTHERN STATES POWER LAKEFRONT SUPERFUND SITE

ASHLAND, WISCONSIN

Constructability Review -- Re: EPA Proposed Plan (June 2009)
August 17, 2009

Prepared for:
Northern States Power Wisconsin
Minneapolis, MN

DCI Environmental • Burns & McDonnell • Sevenson Environmental Services •

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1.0 EXECUTIVE SUMMARY

1.1 PURPOSE

This memorandum provides expert opinions, comments, review recommendations, and supporting information for consideration concerning the United States Environmental Protection agency's (EPA) June 2009 Proposed Plan for the Ashland Northern States Power (NSP) Lakefront Superfund Site (Site) Based on our review and our team's significant experience in sediment and Manufactured Gas Plant (MGP) remediation projects, should EPA decide that sediment removal is required by the National Contingency Plan (NCP), the preferred alternative should be based on wet dredging techniques rather than Feasibility Study (FS) Scenario 10.

Scenario 10 includes Alternative SED-6: Hybrid Remedy (Dry Excavation Near Shore/Dredging Offshore). In summary this is the application of Alternative SED-4 mechanical for the off-shore sediments and dry excavation (Alternative SED-5) of the near shore sediments overlain by woody debris – collectively referred to as Alternative SED-6 Mechanical. Alternative SED-6 Mechanical should not be selected as part of the final remedy because of the following:

- Basal heave risks associated with dewatering;
- Plume mobilization caused by basal heave or pile-driving related hydrofracturing;
- Containment wall design challenges;
- Safety concerns that are not reasonably controllable in a dry excavation approach;
- Availability of wet dredging as a conventional and protective best available technology; and
- Remedy Schedule and Cost

After careful examination of the issues above, the PRAP, and the FS, it was determined that the dry excavation portion of SED-6 Mechanical alternative presents a series of very serious safety concerns, has the potential to cause long term environmental damage to the Copper Falls Formation and Lake Superior, requires solutions to difficult design problems, requires lengthy remediation schedules, and incurs substantially excessive costs without guaranteeing basal heave will not result in flooding that will require the work to be done in the wet regardless of the EPA's intent.

Furthermore, to our knowledge, dry excavation techniques, as promoted by SED-6 Mechanical have not been successfully performed in the Great Lakes. Given the vast technical and safety related challenges associated with this approach, it is more representative of an experimental approach than a recognized best available technology (BAT).

A safer, more proven, and more cost effective remedy that is both protective and effective can be achieved by replacing Sediment Remedial Alternative SED-6 Mechanical with SED-4 Mechanical. Alternative SED-4 Mechanical is comprised of wet mechanical dredging over the entire dredging prism of contaminated sediment removal including near shore and offshore areas.

Assuming sediment removal is required, the final cleanup plan selected by the EPA should include Alternative SED-4 Mechanical for both the off shore and near shore contaminants. Alternative SED-4 Mechanical is a safer, more accurate, and less costly method of attaining the PRG for sediments in the Bay. As the current BAT for the Site, wet mechanical dredging provides a conventional approach to dredging that is protective of the environment and human health and can be accomplished in a more timely and cost-effective manner than Alternative SED-6 Mechanical. Based on our team's decades of experience cleaning up MGP sites, we recommend Alternative SED-4 Mechanical be chosen for the final remedy for the Site sediments.

After the EPA establishes realistic, science-based performance standards, a wet mechanical dredging pilot scale project should be completed to collect the data necessary to design the full scale implementation of the SED-4 mechanical alternative such that the principal hazards of releasing free product and resuspending contaminated sediments and dissolved phase chemicals in the water column are successfully controlled.

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2.0 BACKGROUND

This section provides an overview of the qualifications of the companies responsible for the preparation of this report. It also provides a detailed history of our involvement with the Ashland Northern States Power (NSP) Lakefront Superfund Site (Site) and our objectives and goals for our involvement.

2.1 REVIEW TEAM

Burns & McDonnell, DCI Environmental and Sevenson Environmental Services formed a team for the sole purpose of developing the business opportunities related to the design and construction of the remediation activities that may be completed at the Site. Collectively, our team represents more than 100 years of manufactured gas plant (MGP) remediation experience, with more than 300 soil and sediment MGP projects successfully remediated under our direction. Team members and relevant project experience and qualifications are individually highlighted in Appendix A.

2.2 ORAL TESTIMONY AT PUBLIC HEARING

In the process of evaluating the business opportunities for our team, we reviewed the data and reports made publically available via the internet by the United States Region 5 Environmental Protection Agency (EPA)[1]. As a result of our effort, we recognized that our team had developed insights and technical considerations beyond the scope of the EPA approved Feasibility Study (FS). Furthermore, we came to believe and continue to believe that our insights add considerable value to the efforts of the United States Environmental Protection agency's (EPA) and the Wisconsin Department of Natural Resources (DNR) as they consider and evaluate the EPA Proposed Plan and begin to draft the Record of Decision (ROD) that will select the final remedy for the Site. Finally, we recognize that our mission includes providing technical information on a timely basis when needed to assist former, current and prospective clients achieve success – in this case safe, protective and cost effective remediation efforts that will not require call backs by future generations of Ashland residents.

1 http://www.epa.gov/region5/sites/ashland/index.htm

On June 29, 2009 during the public hearing EPA held to collect comments regarding its Proposed Plan, this team convened to provide oral testimony regarding our professional views of the proposed dry dredge remediation scenario. We chose, at our own initiative, to share portions of the information we collected and our own analyses with Northern States Power Wisconsin (NSPW) and public stakeholders using the public hearing as our platform. Our goals included the following:

- establish our team as a recognized technical expert;
- position our team as a qualified bidder on future solicitations; and
- inform and enable the regulatory community to make the most informed decisions possible as they contemplated the final remedy and Record of Decision (ROD).

Our oral testimony was provided at our own initiative. By testifying in the public domain, we sought to provide the benefit of our experience, in the form of constructive input, as NSPW, the community of Ashland, and the regulatory authorities evaluate a final remedy for the Site. We have attached as Appendix B a copy of the presentation we delivered in the above referenced public hearing and an excerpt of the meeting transcript associated with the presentation. This transcript was prepared by Edwards Court Reporting and is incorporated into these comments by this reference.

2.3 REASONS FOR PREPARING THIS WRITTEN REPORT

Following the delivery of the above referenced oral testimony, our team was invited by NSPW to prepare a written report that explains, in greater detail, the arguments our team presented orally at the public hearing. NSPW stated our report would be submitted to the EPA and DNR for consideration as they seek to complete their evaluation of the final remedy for the Site.

We accepted NSPW's invitation and agreed under paid contract to compile the opinions and evaluation presented herein NSPW provided copies of technical documents to supplement those found on the above referenced EPA website. These are referenced in this report, where appropriate, as well as in the bibliography included at the end of this report. Copies of select documents are also provided as appendices to this report for ease of reference. Where the EPA Proposed Plan is vague or leaves ambiguity regarding technical details of the final remedy, we have made reasonable assumptions and strived to assert them in this report. This report constitutes the independent analysis and conclusions of our team of experts upon review of the PRAP.

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3.0 TECHNICAL CHALLENGES FOR DRY EXCAVATION

Four critical factors for any remedy that includes dry excavation in the bay are examined in this section to highlight the technical challenges associated with FS Scenario 10 and to show why Scenario 10 should not be selected as the final remedy for the Site. These four critical factors are basal heave, plume mobilization, containment wall design; and, most important, safety. Each of the above factors is addressed individually in the subsections below.

It is evident from our discussion below that the FS approved wall system does not provide a safe solution for workers, human health or the environment. While engineering controls can be added to mitigate the factors that result in these risks, the risks themselves cannot be eliminated. To highlight the seriousness of each factor and to show that even a design with the proper engineering controls still may result in significant and intolerable risks/costs, we have compared and contrasted the FS proposed wall system with our proposed alternate cofferdam system, where appropriate.

3.1 BASAL HEAVE

The general cause and effect relationships of basal heave failure associated with a final remedy that incorporates a dry excavation in the bay are generally understood; however, the specific subsurface details that will ultimately determine the likelihood of such failure have not been adequately studied. Given the enormous consequences of such a failure, this section attempts to outline the conditions that might result in such a failure; study the sensitivity of the geologic "system" to inevitable variations among these parameters; and lay out the general short and long term consequences of aquitard failures that might result from the use of any containment wall system to support dry excavation in the bay.

The potential uplift or heave of the Miller Creek formation, as it relates to the potential dewatering and excavation in the dry scenario for the Ashland project, is a concern that is discussed and evaluated in this section. There is generally an artesian condition at the base of the Miller Creek formation indicated in monitoring wells located near the shore line. Specific monitoring wells considered for this evaluation are groundwater monitoring wells MW-24A, MW-25A and MW-26A. The evaluation relied upon review of the following documents (refer to Appendix B):

- draft memo by Foth dated 6/1/09
- figure titled "Hydrogeologic Cross Section and Evaluation of Effective Stress" dated 5/29/09; and
- cross sections of Site borings and monitoring wells developed by URS for the RI, dated 7/30/07

The information and conditions provided in the documents referenced above establish a likely uplift, or basal heave condition where the upward pressure condition at the base of the aquitard exceeds the downward pressure due to the density of the unexcavated materials of the Miller Creek Formation. The calculations provided in this referenced figure are appropriate for the given conditions.

For purposes of discussion and evaluation of the possibility of basal heave failure mode, the Miller Creek formation is assumed to be a homogeneous aquitard. This is representative of a best case scenario and may not represent the actual subsurface conditions. As demonstrated below, basal heave failure is quite sensitive to actual subsurface conditions (e.g. aquitard thickness, unit weight or dry density, planes of weakness from fractures or lenses, etc.) – conditions which have not been adequately investigated or defined to support the development of realistic, engineering decisions. Deviations from best attributes or values assumed in the sensitivity analysis have the potential for increasing the risk of failure due to basal heave.

There are three general factors that influence this uplift phenomena – the thickness of the Miller Creek formation, the potentiometric surface elevation, and the unit weight (or density) of the Miller Creek formation. The excavation is assumed to occur to the top of the Miller Creek Formation, so the downward pressure only considers the thickness of the Miller Creek and the unit weight. The upward pressure condition responsible for the potentiometric surface elevation was assumed to apply at the base of the Miller Creek.

Scenario 10 entails constructing a containment system across a portion of the bay near the shoreline, dewatering within the contained area, and then excavating certain materials within the contained area, generally to or toward the top of the Miller Creek formation. The excavation will occur in an area of the bay for which there is no site specific information related to any of the three critical factors (i.e. thickness of the Miller Creek formation, potentiometric surface elevation, and unit weight (or density) of the Miller Creek formation).

The lithology indicated by means of the geophysical interpretation included in the FS and as illustrated in the above referenced cross-section in combination with more recent monitoring well elevations provided by NSPW were evaluated to understand the potential for variation regarding these three factors. The monitoring wells that were considered are nested, and the data from the deeper screened interval (below the bottom of the Miller Creek) was analyzed. It should be noted that geotechnical laboratory data regarding the unit weight of the Miller Creek and formation thickness needed for design is not available from locations within the proposed dredge area. Furthermore, the only data (other than geophysical interpretations) available regarding the thickness of the Miller Creek was obtained from borings and monitoring wells located along the current shoreline.

Because of the above referenced data limitations, only the impacts that may result from changes in the three critical factors were evaluated. A sensitivity analysis allows for conclusions regarding the potential for uplift and safe design. The results of this analysis (Appendix C) indicate the net pressure at the base of the Miller Creek formation (positive is net downward, while negative is net upward indicating heave or uplift), as well as the factor of safety against heave (greater than 1.0 corresponds to a net downward pressure, while less than 1.0 corresponds to a net upward pressure). Results from the evaluation (as shown on the spreadsheet) are as follows:

- The “base” condition established by Foth and presented in the referenced figure provides a net uplift (heave condition) of 136 pounds per square foot (psf), for a factor of safety against heave of 0.96.

- The unit weight of the Miller Creek likely was assumed to vary by at least five pounds per cubic foot (pcf), depending upon the particular material sample. The factor of safety varied between 0.92 and 0.99 by using the base conditions and varying the Miller Creek unit between 125 pcf and 135 pcf.

- The factor of safety varied between 0.92 and 1.35 considering the actual thicknesses of the Miller Creek formation at boring/monitoring well locations along the existing shoreline, the potentiometric surface elevations, and the unit weight of the Miller Creek. An evaluation of the spreadsheet indicates that of the three variables considered, the thickness of the Miller Creek affects the factor of safety to the greatest degree (within the ranges considered of the other factors).

- The factor of safety varied between 0.94 and 1.34 considering the actual thicknesses of the Miller Creek formation at the three monitoring well locations, and the variation of the potentiometric surface elevations as represented by five readings obtained over a four year period, using the base unit weight of the Miller Creek.

In summary, conditions along the shoreline of the potential excavated area indicate factors of safety from below 1.0 to above 1.3 against uplift or heave of the Miller Creek formation. Considering that there is no information available to evaluate these factors in the area where the excavation would actually be completed (out in the near shore bay area), it is sound engineering practice to apply conservative assumptions regarding this risk particularly where the consequences of being incorrect are so severe. As such, there is the potential that in the area of the proposed excavation, conditions exist which would provide a factor of safety against uplift less than 1.0, or sufficiently low that there would be risk of heave of the Miller Creek during the excavation process.

3.2 PLUME MOBILIZATION

The Copper Falls Formation has a high hydraulic head as a result of confining pressure applied, in part, by the overlying Miller Creek Formation. The confining pressure is sufficient that flowing artesian conditions occur at near shore locations and, presumably, at locations in the bay. Subsurface data beneath the Site clearly show local impacts to the Copper Falls Formation. If a dry dredge remedy is implemented that results in basal heave failure of the Miller Creek Formation, the hydrogeology of the Copper Falls will be locally altered. This may result in a significant change of the stagnation zone conditions described in the RI/FS; it may result in the mobilization of the leading edge of the contaminant plume. Basal heave could result in the creation of permanent preferential flow paths through the Miller Creek and subsequent long term discharge of the dissolved phased plume to the Bay.

In addition to damaging parts of otherwise untainted natural resources (Lake Superior and the Copper Falls Formation), this disturbance may result in a much longer and more costly cleanup scenario that would otherwise be required. The regional hydrogeological interactions of the Copper Falls Formation and Lake Superior have not been studied in detail and are not fully understood. It is possible that any such discharge may take years or even decades to corrupt the integrity of portions of the aquifer and lake that are not impacted during the present day.

It may be asserted that this confining aquitard, like other similar units, has not been and will not continue to be effective in protecting the Copper Falls Formation from being impacted by contaminants in or above the Miller Creek Formation[2]. Confining layer aquitards, such as the Miller Creek in Ashland, were discussed, in detail, during the May 27 – 29, 2009, Monitored Natural Attenuation of Polynuclear Aromatics (PNA) Workshop hosted by USEPA Headquarters and USEPA Mr. David Jewett, PhD, Chief, USEPA Subsurface Remediation Branch, Ada, Oklahoma. DCI was invited to participate in these discussions to explore the misconception of the environmental industry, including Federal and State Regulators, whom too frequently assume

2 NAPL migration to the underlying Copper Falls occurred at the former MGP facility at the upper bluff where there are downward vertical gradients within the Copper Falls. The Miller Creek confining unit is much thinner at the former MGP than at the lakeshore site and has less plasticity There is no indication that contaminants migrated through the Miller Creek Formation at Kreher Park (i.e. from the former coal tar dump area). The leading edge of the NAPL plume in the Copper Falls has never been measured north of the bluff face. The leading edge of the dissolved phase plume in the Copper Falls has never been measured north of the center of the park area (well nest MW-2A/2B(NET)).

clay confining layers are tight and absolute. This false doctrine leads to suggestions that MGP DNAPL and LNAPL can not penetrate through such aquitards. Experience and astute observations suggest that leakage can occur through an aquitard as a result of fractures, partings, lenses, etc. The dry dredge option would require off-shore pilings, and secondary porosity created by piling-induced fractures at this Site could exacerbate leakage conditions.

The reality of any dry excavation approach is that the installation and removal of a containment wall system is that the piling-induced fractures will change the stress conditions of the Miller Creek, which may result in long-term irreversible damage to this confining unit. The installation depth required for the construction of a structurally sound containment wall required for the dry dredge option will likely result in the formation of planes of weakness. Changes in the existing equilibrium conditions may make the aquitard subject to hydrofracturing. Continued upward pressure on the aquitard from the underlying Copper Falls could then result in mobilization of contaminants beyond the existing shoreline into presently unaffected parts of the Copper Falls and Lake Superior. As with mobilization caused by basal heave, mobilization that results from the construction-induced changes to the stress conditions in the aquitard may result in environmental damages that occur over decades or generations.

3.3 CONTAINMENT WALL DESIGN

Scenario 10 requires the near shore portion of the bay to be dewatered, therefore requiring the installation of approximately 1,400 linear feet of dam to hold back all the water. The primary engineering challenge is to design a wall to withstand both the wave and ice loading without damaging the subsurface confining layer (Miller Creek Formation). As indicated at the public meeting we believe we can properly engineer a dam to hold back Lake Superior, however, by doing so we would be exposing our workers, the public, and the environment to what we believe are unnecessary risks, particularly when there is a wet dredge option which can be effectively deployed without incurring such risks. This section examines the wall design presented in the FS and our team’s alternate cofferdam design to demonstrate that while short term failure issues can be designed for, public safety issues associated with air quality and long term environmental risks cannot be eliminated solely by design.

3.3.1 FS Pipe/Sheet Pile Wall

3.3.1.1 Conceptual Design

The FS proposes the use of a cantilevered Pipe Pile/ AZ Sheet Pile Combined Wall System. This system will use 36 inch diameter pipe placed on approximately 7.5 feet centers. The 61 feet long pipes will be driven to elevation 547 (feet above mean sea level) and extend approximately 5 feet above the static water height and be joined by a pair of AZ Sheet Piles. The wall would extend from the Ellis Avenue levee to the Prentice Avenue levee approximately 200 to 300 feet offshore. The FS does not present a schedule for the installation, but based on experience we believe it would take the better portion of a construction season to completely install the wall. The location of this wall in the bay and the linear configuration of the wall preclude the possibility of using bracing or walers to provide additional support for the wall. All of the support is placed on the 61 feet long pipes, which at that length have a real potential for advancing completely through the confining Miller Creek formation and into the Copper Falls formation, which may leave three foot diameter holes every 7.5 feet once removed.

3.3.1.2 Structural Assessment

We completed a structural check of the wall system using both “L-Pile” and “Pile Buck”, industry-standard engineering programs. The input values included a water depth of 10 feet, a wave of 5 feet and a dredge depth, in the dry, of 6 feet. Since the FS extended the wall 5 feet above the water surface standard engineering care requires the loading of that wall; that is why we assumed a 5 feet wave height. Although the FS only documented waves as high as 2 feet; anecdotal evidence provided orally by local residents at the June 29, 2009 public hearing indicate waves greater than 6 feet have been observed.

The results of this analysis indicate that this type of wall may not have sufficient strength or factor of safety to withstand the required load. Furthermore, the FS proposed containment wall is not adequate to withstand a winter season in this location as a component of a drained cofferdam system for the following reasons:

- Our verification of loading on a cantilevered combined pile wall, identified in the FS, considering the heaviest sheeting section available and an empty 36 inch diameter pipe, indicates that a 5 feet wave along the face of the wall is marginally adequate for the loads imparted by the water pressure and wave action . In our opinion, marginally adequate does not instill enough factor of safety to work behind the dam.

- This area of Lake Superior experiences ice thickness of two feet or greater. The typical loading a cantilever wall would experience when retaining earth pales in comparison to the magnitude of the dynamic ice forces resulting from the breakup of a two foot thick sheet of ice. The effect of those ice forces on the pile wall is magnified by their location at the top of the wall. The potential force of ice against a cantilevered pile wall during winter shut down will create a wall failure, if this combined wall system is installed.

3.3.2 Alternative Cofferdam Wall

3.3.2.1 Conceptual Design

Our conceptual design for the dry dredge approach is to create a barrier wall at the Ashland NSP Lakefront Superfund Site with a cellular cofferdam (Figure 2-1). Unlike the FS-proposed containment system, this cofferdam design will withstand the anticipated wave action forces, unbalanced hydrostatic pressure from normal summer weather conditions and ice loads during a winter shut down period.

3.3.2.2 Structural Assessment

Our proposed cellular cofferdam design is a gravity retaining wall. The cellular cofferdam primarily relies on the width and weight of the cells to resist the imparted horizontal loads. The proposed cofferdam cells at Ashland are approximately 22 feet high. Using the average width to height ratio of 0.85 for cells resisting water on a rock base, the required nominal width of the cells is approximately 20 feet. Currently the plan is to install cofferdams with approximately 40 foot diameter cells, providing a factor of safety against overturning greater than the industry standard of 1.1 to 1.25. This will allow a minimal portion of the sheet toe to penetrate into the Miller Creek. Additionally, the fact that the cells will be driven into soil, not bedrock, will produce a higher calculated safety factor against sliding.

3.4 SAFETY CONCERNS

The United States Environmental Protection Agency (USEPA) Proposed Plan (PRAP) (June 2009) which includes the SED-6 Mechanical method for removing sediments and soils from Lake Superior involves the installation of approximately 1,400 linear feet of cantilevered containment wall in order to create a water tight work area can be dewatered to allow for the excavation and removal of “dry” contaminated soils. Working in these conditions will result in several safety considerations that must be mitigated by employing appropriate engineering controls that must be employed to greater extent or in addition to engineering controls required for wet dredging techniques. It is not clear that estimated costs in the FS included budget for the additional engineering controls required to mitigate the safety concerns associated with excavating dry soils (SED-6) compared to the level of engineering controls required for wet removal by conventional mechanical dredging (SED-4). These additional safety considerations and associated engineering controls add cost and uncertainty uniquely to the SED-6 alternative. A summary of each safety issue that can be expected to increase safety hazards and add cost to a final remedy that includes dry removal activities in the bay are provided in each of the following subsections.

3.4.1 Confined or Enclosed Space Entry

Once the cofferdam is constructed, the sediment removal area will meet the current OSHA definition of a permit-required confined or enclosed space. This is any space having a limited means of egress which is subject to the accumulation of toxic or flammable contaminants or has an oxygen deficient atmosphere. Typically, any opened excavation more than 4 feet in depth meets this definition Tar vapors create a potential toxic atmosphere; therefore, all precautions for entering the cofferdam must strictly follow 29 CFR 1910.146, Permit-Required Confined Spaces, to include:

- Employer must certify that supervisors, entrants and attendants are properly trained and knowledgeable of the Confined Space Entry requirements.

- Prepare an entry permit daily.

- Perform continuous air monitoring of the cofferdam to monitor for oxygen, carbon monoxide, flammables and coal tar vapors. Be prepared to evacuate and upgrade to respiratory protection if vapors (BTEX) exceed permissible exposure limits.

- Provide at least one attendant outside of the cofferdam at all times while entrants are within the confined space.

- Employer must designate rescue and emergency services that have full capability of responding in a timely manner and properly equipped and proficient in performing the needed rescue services. Most employers set up service agreements with an outside Emergency Medical/Fire services to provide for adequate rescue capability.

OSHA has recently published a proposed change—Confined Spaces in Construction and the period for comment expired on Feb 28, 2008. Because of the numerous comments, the final rule is still pending. The proposed Rule is more arduous as it lists four different classifications of confined space for construction workers. (The cofferdam would fall under the Continuous System Permit Required Confined Space.) Under this proposed rule, Burns & McDonnell would be required to determine and implement isolation or control methods for all identified hazards. All hazard assessments and identified protective measures would have to be documented. All the remaining critical elements from the current standard would still be applicable.

3.4.2 Respiratory Protection

Based upon historical personal air monitoring data collected at previous MGP remediation projects, respiratory protection for workers within the cofferdam must be anticipated. The contaminant of concern that drives the need for respirators is benzene with a low threshold exposure limit of 0.5 parts per million by volume (ppmv) for an 8-hr work shift. Naphthalene is also present in tar vapors and creates a noticeable odor, but usually at levels well below the exposure limit value. This odor can be an irritant to workers inside a confined space and it also presents community concerns for residents. The likelihood for air-purifying respirators for workers is high (Level C) and the need for air-supplied respirators (Level B) can not be ruled out when remediating dry sediments heavily impacted with tars. The minimum requirements for the respiratory program are established in 29 CFR 1910.134, Respirator Protection, and include:

- Medical evaluations (annually) of employees required to use respirators;
- Fit testing (annually) of employees using tight-fitting respirators;
- Establish procedures for proper use of respirators in routine and reasonably foreseeable emergency situations;
- Establish procedures for cleaning, disinfecting, storing, inspecting, repairing and otherwise maintaining respirators;
- Training of employees in the site respiratory hazards;
- Establish procedures to ensure adequate air quality, quantity, and flow of breathing air for atmosphere-supplying respirators;
- Procedures for regularly evaluating the effectiveness of the program.

Air dispersion modeling results from the URS Bench Scale Air Emissions Treatability Study included in the FS indicated that, under several of the remedial scenarios, receptors outside the Site work area would be exposed to naphthalene and benzene above health risk levels. The model predicted that under the worst case condition a much larger area outside of the immediate work area would be above the benzene standard than the naphthalene standard. Similarly, modeling of odor dispersion indicated odor detection units above one odor unit would be experienced beyond the immediate Site work area under some remedial scenarios.

URS' model indicates that dredging with onshore dewatering and stockpile pond areas may emit naphthalene and benzene at concentrations above acceptable DNR air quality threshold values at locations near the source. Engineering controls may be required to mitigate emissions from onshore material handling operations regardless of the dredging technology selected for the final remedy.

URS' study stated that there are many uncertainties with odor modeling and actual occurrences. Our experience validates this assertion. We believe the community of Ashland will experience detectable odors during the remediation activities. Even if all onshore activities are subjected to adequate engineering controls, transport of mechanically removed debris and sediments from the bay will result in odiferous emissions. Our experience agrees with the URS study that such occurrences will be transient and limited in extent pending actual wind conditions.

URS's emissions study model did not include the dry dredge option. Our experience is that any dry remedy will result in higher air emissions unless the disturbed area is severely restricted at any one time. This type of approach would result in a tremendous cost increase that has not been evaluated as part of this report.

3.4.3 Truck Access

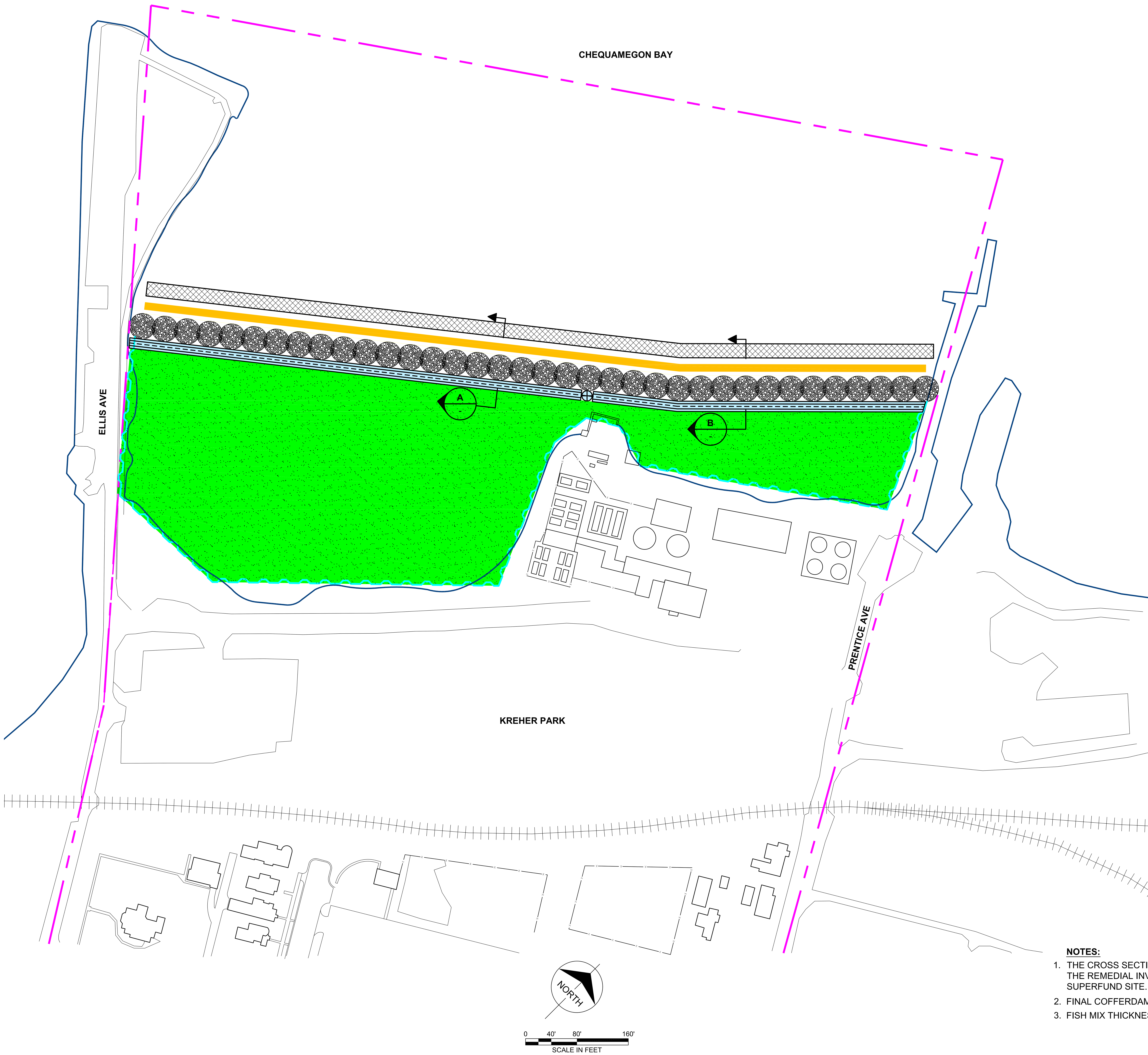
The planned access for earthmoving equipment and haul trucks within the confines of the cofferdam will require construction of earthen ramps. These ramps will likely extend to and include the placement of fill on the Lakebed. The State of Wisconsin has raised implementability concerns regarding the placement of fill material in the Lakebed occasioned by the proposal to construct a confined disposal facility (CDF). It is not apparent that the Plan took into account the implementability of the placement of fill needed to construct such access ramps. The ramps must be constructed to a standard that provides for safe access of heavy equipment to include controls to eliminate physical hazards such as tip-over, struck by, falls from elevation, confined spaces, congestion, etc.

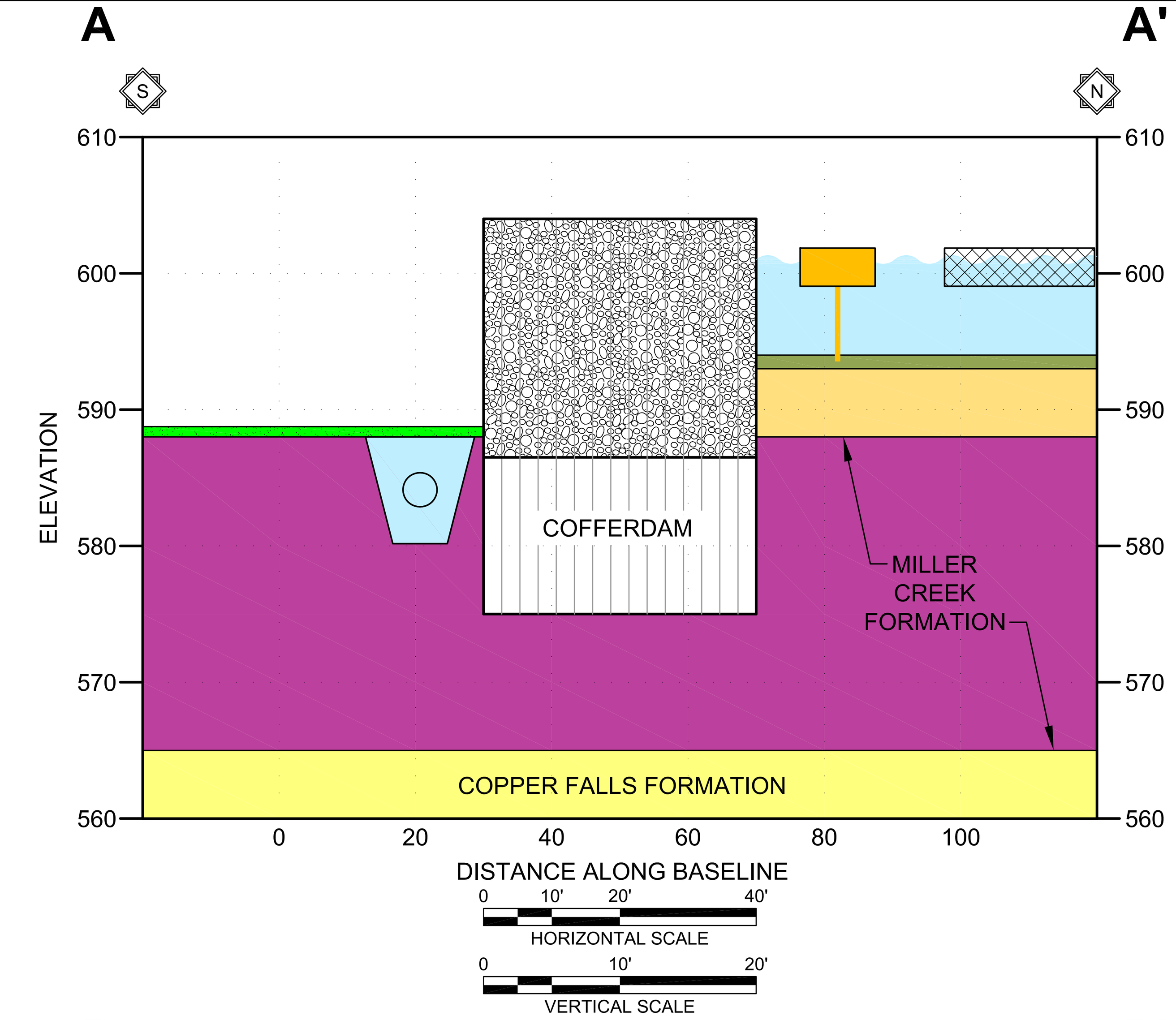
3.4.4 Carbon Monoxide

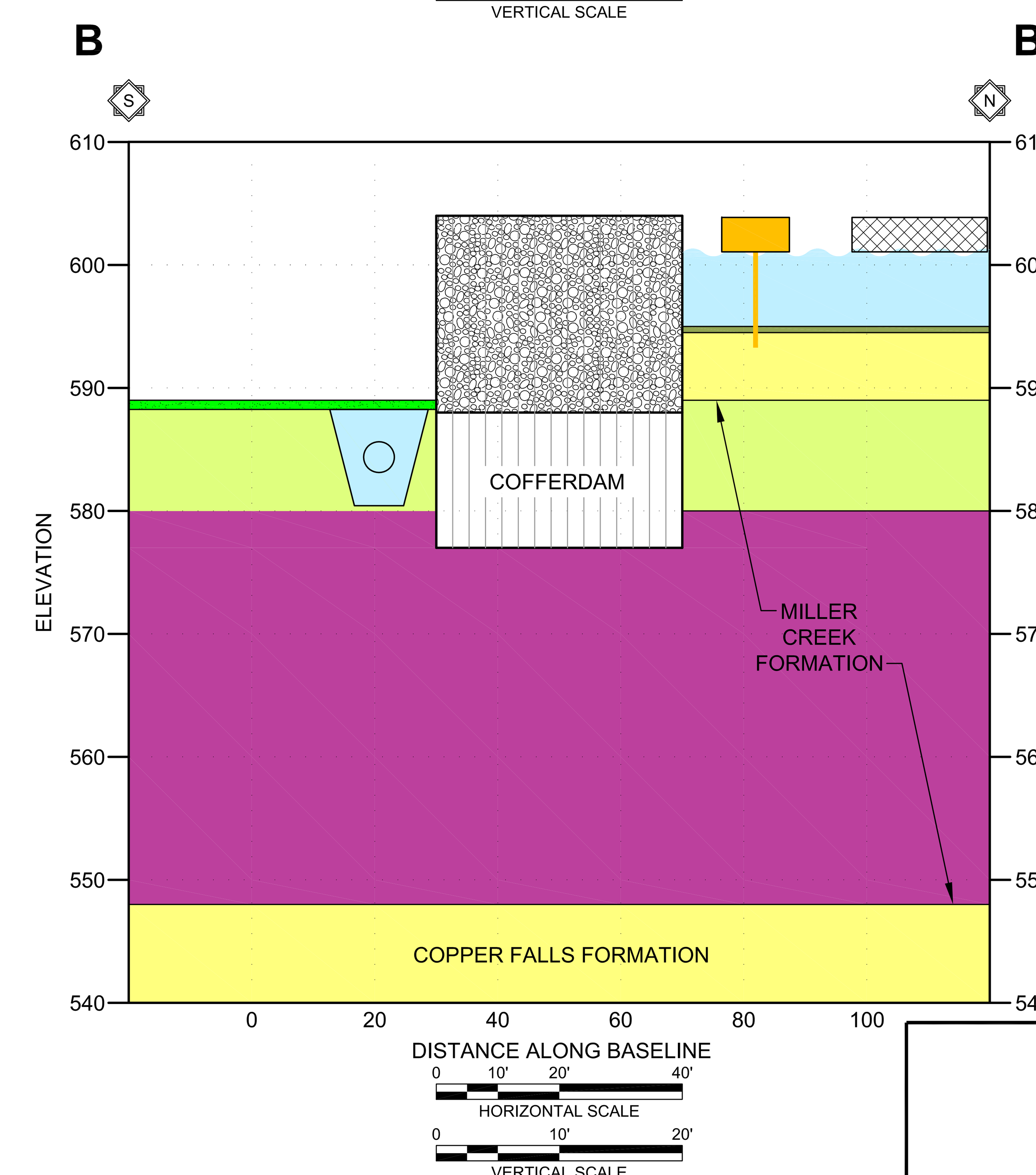
Depending upon the number and type of diesel equipment within the cofferdam; the carbon monoxide (CO) levels must be continuously monitored to ensure worker safety. Elevated CO levels are likely to rise above permissible levels unless engineering controls are utilized.

Exhaust scrubbers or soot filters will likely need to be added to all diesel equipment used within the cofferdam.

* * * * *







LEGEND

- SITE BOUNDARY
- SILT CURTAIN/OIL BOOMS
- SHEET PILE
- WATER
- WOOD
- SAND
- SILTY SAND
- SILT
- CLAY
- COFFERDAM
- SEEPAGE DRAIN
- PUMP STATION
- WAVE ATTENUATOR
- COVER/FISH MIX
- STONE

NOTES:

1. THE CROSS SECTIONS DEPICT THE ANTICIPATED GEOLOGY DERIVED FROM BORINGS PRESENTED IN THE REMEDIAL INVESTIGATION REPORT ASHLAND/NORTHERN STATES POWER LAKEFRONT SUPERFUND SITE. ACTUAL GEOLOGY WILL BE DETERMINED DURING DESIGN PHASE
2. FINAL COFFERDAM DESIGN IS DEPENDENT ON ACQUISITION OF ADDITIONAL DESIGN CRITERIA.
3. FISH MIX THICKNESS TO BE DETERMINED AFTER PILOT STUDY OF SUPPLEMENTAL INVESTIGATIONS

date 08-03-09	detailed L. SAUCEDO
designed M. SWIECA	checked

DCI Environmental • Burns & McDonnell • Severson Environmental Services

FIGURE 3-1
CONCEPTUAL COFFERDAM LOCATION
FOR DRY DREDGE HYBRID
ASHLAND, WI

project 53587	contract
drawing	rev.
sheet	of sheets

file J:\ENV PRACTICE\XCEL ENERGY\ASHLAND, WI\CAD\XSECTIONS

4.0 AN APPROACH FOR WET MECHANICAL DREDGING

4.1 OVERVIEW

As stated in Section 3.0, execution of a final remedy based on Alternative SED-6 Mechanical as included in FS Scenario 10 will result in an unnecessarily large spend and potentially unsafe work environment. Structural assessment of the wind, water and ice loads that any wall system will be subject to have clearly shown that a cantilevered containment wall design may not afford a reasonably safe work environment to achieve the future performance standards (PS). Although it is possible to design a cofferdam wall that will provide a safe work environment, it is not without hazard. There is a real and reasonable risk of basal heave failure that may result in long term environmental damage resulting from remobilization of an otherwise stagnant contaminant plume. Remobilization of contaminants would result in long term environmental damage to the Copper Falls Formation and Lake Superior as described in Section 3. In addition, if basal failure occurs, the work will be completed in the wet regardless of money and effort expended on creating a “dry” excavation environment.

The PRGs may be achieved with reasonable costs and minimal risk to human health and the environment based on Alternative SED-4 Mechanical as included in FS Scenario 4. Alternative SED-4 Mechanical is comprised of wet mechanical dredging over the entire dredging prism of contaminated sediment removal including near shore and offshore areas and is described more fully in this Section. Table 4-1 provides a comparison of major components for the two sediment removal alternatives. The items identified with bold text and shaded cells are items we believe are areas that represent fatal flaws for SED-6 Mechanical and as such fatal flaws for the Proposed PRAP.

Table 4-1. Dredging Alternatives Comparison

Major Items of Work	**SED-4 Mechanical**	**SED-6 Mechanical**
Wet Dredging	Near and Offshore Areas	Offshore Area
Dry Excavation	No	Near Shore Area
Containment Wall	No	**Yes**
Silt Curtains/Wave Attenuators	Yes	**Yes**
Lake Dewatering System	No	**Yes**
Seepage Control/Treatment System	No	**Yes**
Upheaval Risk	No	**Yes**

Thermal Treatment and Disposal	Yes	Yes
Bottom Cover	12 Inches	6-12 Inches
Air Emission Monitoring	Yes	**Wet Dredge Only**
Water Quality Monitoring	Yes	**Wet Dredge Only**
Biological Monitoring	Yes	No
Duration of Project	1 Year (3 mos. for pilot)	**2+ Years**
Cost	$35 million	**$73 million**

Based on safety, environmental risk, cost and schedule our team has designed a preliminary mechanical wet dredge approach for the SED-4 Mechanical Alternative over the entire Site that will achieve optimum results during the completion of the Ashland project.

In order to ensure the success of wet dredging, realistic, science-based performance standards need to be developed for the Site as the basis for any specific applied clean-up goals. It is not sufficient to develop performance standards after pilot testing as part of a "design phase" of the project. It is important to define the goals before deigning the pilot test procedures. Once such standards are in place, the pilot test forms the basis of the design for the full scale wet dredge removal remedy.

The following sections outline a brief path toward completing the design for this safe and cost effective alternative approach.

4.2 PILOT TESTING TO SUPPORT FINAL WET DREDGE DESIGN

A recent government report on environmental dredging operations, “The Four Rs of Environmental Dredging: Resuspension, Release, Residual, and Risk”2, reinforce the importance of a thorough and conclusive pilot test as part of design efforts for dredge work. This position is reflected in the findings of a workshop referenced therein on environmental dredging that identified the difficulties associated with addressing data gaps, accurately modeling the impacts of dredging and successfully managing the 4Rs. The report concludes that monitoring should be structured to test specific hypotheses concerning risk reduction including precise data collection and analysis that can be used to adjust predictive models for future similar environmental dredging projects. The report also recommends that additional focused pilot or

[2] USACE; ERDC/EL TR-08-4. 2008.

research studies of resuspension and releases (uncontrolled) should be performed to compare pre-dredging prism concentrations and post-dredging average surficial concentrations. The pilot project should also include adaptive management and a staged or phased approach to better control the extent of cross contamination and provide time to make changes in methods and procedures, using less invasive and costly remedies.

Based upon our team's experience and these findings and recommendations, the following hypothesis for a pilot project is proposed: current best available technology (BAT) measures exist for wet mechanical dredging and can be used to safely remove contaminated sediments including woody debris at or below PRGs or PS (to be developed) in the near shore area of Chequamegon Bay (Bay).

4.2.1 Pilot Program Work Plan

A detailed Pilot Program Work Plan (PPWP) and Supplemental Site Investigation Work Plan (SSIWP) will be necessary to plan for and collect the data needed to complete a design for wet mechanical dredging within the near shore area. The PPWP and SSIWP should include many of the methods and strategies identified in the report, "Technical Guidelines for Environmental Dredging of Contaminated Sediments"[3]. The pilot wet mechanical dredging work plan should incorporate a series of plans, controls, methods and strategies. For the readers' convenience, each is grouped into the management and BAT categories and plan components as follows:

- Health and Safety Plan
- Supplemental Site Investigation Plan
- Monitoring Plan – real time monitoring of air, water, sediment, and aquatic organisms
- Pilot Dredging Plan
- Environmental Protection Strategies
    - Physical Controls: BATs to control contaminant releases including free product, dissolved phase product, suspended sediments, residuals, and aquatic organisms
    - Operational Controls: BATs to control sediment disturbance limits including primary dredge prism, sediment management units, and dredging management units

[3] USACE; ERDC/EL TR-08-29. 2008.

    - Contingency Measures: BATs to prevent wide spread cross contamination
    - Sediment Processing: BATs for treating dredged sediments
    - Waste Disposal: BATs for disposal of sediments and other project derived wastes
    - Water Treatment: BATs for water treatment and disposal
    - Institutional Controls– adaptive management procedures to execute needed changes
- Bench Scale Testing
- Reporting – daily, weekly, monthly and final progress
- Schedule and Permits

Table 4-2 provides a listing of the potential major items of work and methods and strategies that the Pilot Project should examine to prepare a final dredging plan to be employed at each dredging location, i.e. near shore and offshore areas.

Table 4-2. Wet Mechanical Dredge Methods and Strategies

Item of Work	**Near Shore**	**Offshore**	**Land Treatment**	**Comment**
A. Baseline Surveys				
1. Sediments	Yes	Yes	No	CWD
2. Water Quality	Yes	Yes	No	CC
3. Air Quality	Yes	Yes	No	CC
4. Biological	Yes	Yes	No	CC
B. Dredging				
1. Prism	Yes	Yes	No	SMU (2)
2. Cuts	Yes	Yes	No	Multiple DMUs
3. Clean Up Passes	Yes	Yes	No	2
C. Environmental Controls				
1. Wave Attenuator	Yes	Yes	No	1
2. Silt Curtains	Yes	Yes	No	Double/Stagger
3. Oil Booms	Yes	Yes	No	Inside/Outside
4. Water Treatment	Yes	Yes	Yes	
D. Sediment Processing	No	No	Yes	
E. Final Cover	To Be Determined	To Be Determined	NA	Fish Mix
F. Monitoring	Yes	Yes	Yes	
G. Reporting	Yes	Yes	Yes	

Notes: CWD – Characterize woody debris; CC – Current Conditions; SMU – Sediment Management Unit; DMU – Dredging Management Unit

4.2.2 Pilot Strategies for Success with Wet Dredging Remedy

The following are some key strategies and current BATs we believe should be part of a successful wet mechanical dredging pilot project. Based on our experience, employment of these key strategies and current BATs will provide assurances for success for the full scale dredging plan.

- Collect background air, water, sediment (including woody debris) and biology (benthos and fish) samples and perform testing to determine and set allowable limits for TSS, PAH, TPH, and other potential contaminants within and adjacent to the wet dredging boundary(s).

- Perform bench scale supernatant jar test for polymer and flocculent agents and establish best application methods and rates for flocculating TSS.

- Prepare dredging prism and two primary Sediment Management Units (SMU); near shore, and offshore; and multiple dredging management units (DMU) for each SMU. The limits of each DMU will be determined by the analysis of current sediment and water quality information. The pilot area will be located within the near shore SMU.

- Installation of a temporary floating breakwater system to control and mitigate potential wave action and reduce affects of turbulence on the barge mounted dredge equipment, floating access ramps, and the affects of water currents on silt curtains and oil booms mounted leeward.

- Installation of silt curtain systems with staggered joints and oil booms around the perimeter of each dredging management unit to control the migration of suspended materials and floating product.

- Wet mechanical dredging equipment will include barge mounted environmental clamshell buckets with water-tight seals, and lined roll-offs (or barges during full dredging operations) with bibs to control spills and mixing of contaminants in the water column.

- Use dredging techniques that minimize sediment disturbance including restriction to one dredge bucket bite per pass and no bottom stockpiling.

- Track dredging progress with high precision Real Time Kinematic (RTK) Global Positioning System (GPS) that will locate the dredge bucket within 0.2 tenths of a foot for each bucket "bite". The dredging software provides a real time view for the contractor for each bucket bite.

- Verify water depths using single beam or multibeam hydrographic surveys. Multibeam hydrographic surveys would be completed on a daily basis and provide 100% coverage of the days progress. Once the data is processed it can be displayed on grid as small as 5' by 5'.

- Install vapor and odor barriers by covering sediment materials placed in barges or lined roll-offs with a thin layer of water on top of the materials or spraying a surfactant foaming agent.

- Set up emergency water contaminant control center within the perimeter of each DMU to be operated by a separate local response contractor. The center would contain equipment and materials such as pumps, skimmers, hoses, absorbent pads, flocculants, and other materials to intercept, control and treat uncontrolled releases within the water column.

- Perform water sampling and testing for contaminants of concern before, during, and after each wet dredging cycle.

- Perform bottom sediment sampling and testing within the demonstration boundary at conclusion of wet dredging.

- Place final fish mix cover and perform final sediment sampling and testing to confirm PRG limits have been satisfied.

4.3 FULL SCALE EXECUTION OF WET DREDGE ALTERNATIVE

As stated above, following the development of realistic, science-based performance a successful pilot is required to collect the necessary data needed to complete the design work required prior to the implementation of the full scale Alternative SED-4 Mechanical approach. This approach would include the mechanical dredge and removal of the wood debris and transportation of the wood to shore for processing, then mechanically dredge the sediments to a targeted elevation and PRG.

A robust confirmation sampling strategy will be necessary to confirm and document the performance standards have been met after confirmation of the sediment removal has been completed to the specified target elevation. In our experience, the following general procedures comprise a robust confirmation sampling protocol that could be executed with success at the NSP Site.

> Post dredge confirmation samples would be comprised of five core samples collected in each dredge verification unit. The purpose of collecting these samples will be to confirm and document the applicable PS have been achieved. It is anticipated that for the remedial design, each verification unit will be on a 100 x 100 grid. The core samples themselves will be collected in a geometric grid within each verification unit. The top six inches of each core will be sampled and extracted for subsequent analysis of PAHs. The extraction associated with the sample collected from the center of each grid will be analyzed for PAHs. The results of the first sample will be used as a preliminary confirmation sample for the subject dredge verification unit. If any preliminary confirmation sample contains a concentration of total PAHs above the PS, the extractions from the other samples in the subject dredge verification unit will be analyzed for PAHS. The PAH concentrations of these four results and the result from the associated preliminary confirmation sample will be averaged to create a composite confirmation sample for that unit.

If the results of the composite confirmation sample do not meet the PS, additional clean up passes along the bottom will be required to remove remaining impacted sediment. Cleanup passes can be as simple as scraping the surface, or removing an additional lift of soft sediments and collecting a new set of sediment cores. These cores will be subjected to the same post dredge confirmation sampling procedure described above.

After the completion of any clean up passes required, two lifts of a sand/gravel/cobble (fish mix) cover should be installed over the entire dredge area including the side slopes. After the cover has been placed, five cores should be collected from the newly placed cover in each dredge verification unit. These cores need to penetrate the entire depth of the cover. Two cover samples should be collected from each core – representative of each lift. These samples should also be subjected to the same post dredge confirmation sampling procedures described above to evaluate cross contamination within the cover and to verify residual PAHs meet the yet to be determined PS.

At each stage where sampling occurs, sediment and cover samples must be collected in accordance with an EPA and/or DNR approved Quality Assurance Project Plan (QAPP) that clearly identifies procedures pertaining to sampling and analysis. This plan should be prepared and submitted along with a health and safety plan (HASP) prior to Mobilization. We have developed and submitted such procedures and plans which were subsequently approved by the DNR and USEPA Region 5 for Sevenson's previous Fox River, WI projects. It is anticipated that the procedures that Sevenson has worked under on Operating Units (OU) 56/57 (2000) and Phase I dredging (2007) of the Fox River will be adapted and approved for the Ashland project.

Based on our experience, we believe a wet dredge approach that incorporates the attributes described above will allow the Site to meet the remediation goals for post dredging and sand placement over the residual bottom sediments. Furthermore, this work can be completed within 1-year using wet dredging. This same approach was very effective in achieving very low remediation goals on OU 56/57 in the Fox River clean up.

4.4 TECHNICAL ADVANTAGES OF WET DREDGE METHOD

Based on our analysis of the RI/FS and the PRAP, wet dredging for the entire Site (SED-4) is the preferred remedial method based on our experience, safety risks to both human health and the environment, implementability, costs, timeliness of project implementation and technical approach. Specifically, the technical reasons include:

- The water column remains over the contaminated sediment and debris as opposed to exposing the entire mass to the atmosphere where emissions and odors from contaminants and decaying organics would be a greater issue. Keeping materials submerged under water will minimize exposure risk of SVOCs and VOCs to the surrounding community and the workers on Site. Potential free product releases (floaters) and dissolved phase contaminants will be controlled by BAT including oil booms and water circulation and treatment systems. Materials in barges can be covered with water by pumping a thin layer of water on top of the material or sprayed with a foaming agent to reduce vapors and odors during transportation to the temporary stabilization building. Dry dredging would require the entire exposed area to be managed for SVOCs and VOCs.

- Mobility of equipment in the dry would be limited to areas where foundation materials would allow low ground pressure equipment to work. Due to the low shear strength of the soils, trucks, large excavators and bulldozers, could not enter the Site for ease of material removal with out increasing the volume to be removed. Loose non-contaminated sediments under the contaminated sediments could easily be cross contaminated by the equipment during dry excavation of upper contaminated materials. Materials would have to be shuttled to a near shore area using low ground pressure track dumps to areas where an excavator could pick it up and place it into an off road truck for transport to the processing area. This would require multiple material handlings at an inefficient rate, increase the involvement of material resulting in more emissions and odors and require an extensive system of temporary haul roads. The wet dredge approach promotes waste minimization.

- Repetitive movements/machine vibrations using the dry excavation approach on materials with low shear strength could cause localized material failures posing safety risk to workers, loss of equipment, and mixing of clean materials with contaminated materials at the proposed dredge prism interface.

- Wet mechanical dredging will be just as accurate as dry dredging, based on our wealth of sediment removal experience. A high precision Real Time Kinematic (RTK) Global Positioning System (GPS) should be used that will locate the dredge bucket within 0.2 tenths of a foot for each bucket "bite". The dredging software provides a real time view for the contractor for each bucket bite. Water depths can be verified using single beam or multibeam hydrographic surveys.

- Multibeam hydrographic surveys would be completed on a daily basis and provide 100% coverage of the days progress. Once the data is processed it can be displayed on grid as small as 5' by 5'. Conventional dry survey methods would not provide this detailed information in real time.

- Limiting migration of suspended materials and floating product will be accomplished by using a silt curtain system with oil boom(s), oil absorbent "socks", and water control and treatment systems. Similar systems have been used successfully in high tidal energy environments; therefore, we are confident that this approach will limit migration of suspended materials and floating product.

- Setting up a temporary floating breakwater system will mitigate potential wave disturbance on the silt curtains, oil booms, and barge mounted dredge equipment and floating access ramps. This system could be constructed from Flexifloat type barges or specifically manufactured wave attenuators. (http://www.waveeater.com/waveeater_install.aspx).

- Wet dredge techniques eliminate uncertainties related to potential piping/artesian flow and storm water accumulation that would otherwise require extensive dewatering and significant water treatment during a dry-dredging remedial approach. Continuous dewatering is also energy intensive (pump energy, water treatment energy), very costly requiring backup pumping systems, and is not a sustainable option in terms of resource conservation.

Wet dredge techniques are a proven technology with predictable timeframes and are more cost-effective than dry dredge approaches. There is no risk of basal heave with a wet dredge approach. The schedule for performing wet dredging is more reliable when compared to the uncertainties associated with dry dredging.

* * * * *

5.0 SCHEDULE AND COST IMPACTS

The Site data presented in the Remedial Investigation was reviewed, and a remedial approach was developed with the 9.5 µg tPAH/g dwt PRG in mind. Our team applied its extensive MGP and sediment remediation construction experience to the approach, and was able to provide the constructible costs for the two options.

5.1 SCHEDULE CONSIDERATIONS

In assessing the sequence of work required to implement the wet/dry hybrid proposed in the PRAP or the wet dredge recommended by our team, we developed detailed cost estimates representative for either remedy. As a result of this analysis, we determined that a realistic milestone schedule associated with EPA's proposed plan would result in an extensive additional duration compared to the schedule that would be associated with our approach for a wet dredge remedy. Any final remedy that results in an extended duration will result in longer term public relation impacts, including the following:

- traffic disruption by project support equipment
- extended odor presence loss of use of the marina and bay for an unnecessarily long time; and
- additional overhead and remediation costs that could have been avoided.
- delay of implementation of the City's Waterfront Redevelopment Plan

5.1.1 Dry Dredge Alternatives

Schedule impact marks the simplest distinction between Alternative SED-6 Mechanical and SED-4 Mechanical. Regardless of which wall technology is considered, Alternative SED-6 Mechanical requires a minimum of two construction seasons.

- The structural deficiencies of the FS approved cantilevered containment wall system virtually assure that the system would require removal prior to icing conditions and replacement the following spring. It will not be possible to complete dry-dredging in one season, which would require reinstallation of components, repeat of dewatering and extensive cost overruns, not to mention disruptions within the local community.

- The cofferdam construction sequence is a monumental task and will require nearly an entire construction season just for its completion leaving the actual dredging work to begin the following construction season. In summary, any wet/dry hybrid solution cannot be completed in a single construction season.

5.1.2 Wet Dredge Alternative

The inherent multi-season schedule of Alternative SED-6 Mechanical is in stark contrast to Alternative SED-4 Mechanical. We have evaluated the wet dredge approach from a line-item activity level. Our assessment has confirmed that Alternative SED-4 Mechanical can be completed in one construction season if the pilot dredge project and ancillary Site work / mobilization are completed in the prior season and left in-place to support the subsequent season's dredging activities.

5.2 BUDGET CONSIDERATIONS

A summary of the Wet Dredge (SED-4 Mechanical) and Dry Dredge (SED-6 Mechanical) remediation costs are presented in Appendix D. We estimate the construction costs of a safe approach to Alternative SED-6 Mechanical will be approximately $73 million. By way of contrast, we estimate the construction cost of Alternative SED-4 Mechanical is approximately $35 million. Note that the approximately $38 million delta between these approaches is slightly nearly twice as much as the approximately $18 million delta presented in the FS. Primarily, this disparity is due to differences in the wall design requirements discussed in Section 3.0 of this report.

5.2.1 Dry Dredge Alternatives[4]

The dry dredge option presents the more difficult and uncertain challenges of the two options and, consequently, bears the highest estimated construction costs. These elevated costs are a direct result of the significant challenges associated with the execution of this alternative. Notably, these challenges include holding back the bay safely, controlling odors over a large area of exposed impacted sediments and maintaining the integrity of the Miller Creek aquitard.

[4] A budget analysis of the FS approved cantilevered containment wall system was not completed due the unsafe and impractical nature of this application. This section focuses on the proposed cofferdam alternative.

Holding back the bay introduces a number of tasks not found in the wet dredge option (i.e. installation of cofferdam wall, backfill cofferdam, cofferdam removal, removal under dam and backfill under dam). As noted above, this also results in extending the duration of the project by at least a year. These additional activities and the extended schedule account for the majority of the $38M difference between the two options.

Odor control will be a significant challenge associated with this approach for the following reasons:

- close proximity of human receptors
- foul nature of the odors to be generated
- prevailing winds that will drive the odors toward these receptors
- relatively high concentrations—low odor threshold of benzene
- the low odor threshold—high toxicity of naphthalene

Because of the above, the control of odors during this project will be of the upmost importance. Exposing the bay floor will increase the disturbed area and create a proportional increase in gross emissions that exasperate odor issues. In the worst case, the larger surface area of an uncovered bay floor may present a condition of uncontrollable odors. The odor control costs associated with this alternative is more than double that needed for the wet dredge alternative. Furthermore, even with the additional odor controls, it cannot be guaranteed that nuisance odors can be prevented.

A hidden and unaccounted for cost may also ultimately be incurred as a result of any dry excavation activity if the Miller Creek is disturbed to the point of basal heave failure. Presently the Miller Creek aquitard is balancing the artesian forces of the Copper Falls aquifer and causing the stagnation of the existing DNAPL plume. The installation and removal of the cofferdam sheeting combined with the removal of the bay water and overburden sediment may create failures in the Miller Creek as previously described in this report. Such failures may, in turn, mobilize this DNAPL plume. Monies required to address a newly mobilized plume would be above and beyond the dry dredge option cost of $73M described herein.

5.2.2 Wet Dredge Alternatives

The wet dredge option presents the path of least resistance and thus the lower construction cost estimate of $35M. The obstacles this option presents are; containment of the impacted suspended solids, confidence that the bay floor is clean, and odor control.

The obstacles of the wet dredge alternative can be mitigated with the use of Best Available Technologies (BAT) as described in Section 4.0. Briefly, some are described here. The containment of the suspended sediment will be handled with a series of silt curtains, booms and monitoring, and can be enhanced with other proven methods, if necessary. The sediment floor will be sampled with standard sampling techniques in a geometric pattern. As an additional check, underwater photography can be used to document the dredging.

The most noticeable portion of the remediation will be the control of odors. Among the many technical advantages of the wet dredge (refer to Section 4.0) is the fact that the water will remain in place as an odor blanket and resolve many of the odor issues described above that plague the dry dredge alternative. Removed sediments will be brought land side for dewatering and stabilization. The sediment processing area will be covered with a temporary building to control the odors.

Finally, the wet dredge activities can be completed in a single construction season thus reducing overhead expenses. The wet dredge approach results in the most prudent spend for achieving the PRG for the Site.

* * * * *

6.0 CONCLUSION

In the PRAP, EPA recommended Scenario 10 from the FS. This includes Alternative SED-6: Hybrid Remedy (Dry Excavation Near Shore/Dredging Offshore). In summary this is the application of Alternative SED-4 mechanical for the off-shore sediments and dry excavation (Alternative SED-5) of the near shore sediments overlain by woody debris – collectively referred to as Alternative SED-6 mechanical.

The dry excavation portion of SED-6 Mechanical alternative presents a series of very serious safety concerns, the potential to cause long term environmental damage to the Copper Falls Formation and Lake Superior and difficult design problems with more untested solutions than the wet mechanical dredging option. Without extensive engineering controls, the EPA proposed dry excavation provides virtually no factor of safety against basal have at select near shore locations. As a result, the dry excavation remedy may result in catastrophic flooding and remobilization of the currently stagnant plume in the Copper Falls Formation. This approach also poses substantial air quality control issues that could, at worst, result in unacceptable human health exposures to benzene for nearby residents and, at minimum, create a significant odor nuisance due to naphthalene. In addition, this approach appears to create even greater risks and uncertainty to the long term stability and control of residual contamination. This is particularly evident in the potential for permanently disrupting the Miller Creek aquitard and allowing mobilization of the stagnant plume in the Copper Falls and possible, uncontrolled releases to Lake Superior. This approach requires a significantly longer schedule due to the fact that a proper containment wall will require most of a single construction season to construct. This will require the bay to be removed from public use for an unnecessarily long time. Finally, the proposed dry excavation option is also much more costly – it exceeds the cost of wet dredging by at least $38 million, possibly more.

To our knowledge, dry excavation techniques, as promoted by SED-6 Mechanical have not been successfully performed in the Great Lakes. Given the vast technical and safety related challenges associated with this approach, it is more representative of an experimental approach than a recognized best available technology (BAT).

In fact, as we stated at the public hearing (refer to Appendix A), if asked to bid or complete work that risked basal heave due to the above conditions as a result of a final remedy that required dry excavation to be completed in the absence of sufficient engineering controls, without exceptions, we concluded that our team would decline the opportunity to price the work[3] unless sufficient exceptions or alternates were allowed on a negotiated basis to protect the safety of our workers and the environment from the risks described above.

Should EPA determine that sediment removal will be required in the ROD, the final cleanup plan selected by the EPA should include Alternative SED-4 Mechanical for both the off shore and near shore contaminants. Alternative SED-4 Mechanical is a safer, more accurate, and less costly method of attaining the PRG for sediments in the Bay. As the current BAT for the Site, wet mechanical dredging provides a conventional approach to dredging that is protective of the environment and human health. Based on our team's decades of experience cleaning up MGP sites, we recommend Alternative SED-4 Mechanical be chosen for the final remedy for the Site sediments.

After the EPA establishes realistic, science-based performance standards, a wet mechanical dredging pilot scale project should be completed to collect the data necessary to design the full scale implementation of the SED-4 mechanical alternative such that the principal hazards of releasing free product and resuspending contaminated sediments and dissolved phase chemicals in the water column are successfully controlled.

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3 Oral Testimony provided on June 29, 2009 at public hearing in Ashland, WI, Page 53, Line 5 of Edwards Court Reporting Transcript.

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APPENDIX A – Review Team Biography

Burns & McDonnell

Burns & McDonnell specializes in the environmental remediation of contaminated sites. Burns & McDonnell's involvement typically extends from investigation to remedial design to construction to operation and maintenance and ultimately to closure. Team members have extensive experience with field engineering aspects and reviews for a full range of remedial technologies constructed under the RCRA and CERCLA programs. The firm has extensive experience in the engineering and documentation required by such projects and has successfully addressed them on existing and past projects. Unlike many firms active in the hazardous waste field, Burns & McDonnell is also a design firm rather than exclusively a "study" organization. For over 110 years, Burns & McDonnell has been heavily involved in the design of water, wastewater and industrial waste treatment facilities and we have built on this experience to become leaders in the design of remedial measures at hazardous waste sites. Large sediment dredging projects by Burns & McDonnell staff include extensive dredging work at Waukegan Harbor, IL. In addition to a wide range of engineering disciplines, Burns & McDonnell has a full staff of geologist, geohydrologist, chemists, sediment specialists, environmental scientist, biologist, aquatic ecologist, and other environmental specialists to support dredging projects and assist with controlling environmental impacts to the natural environment.

DCI Environmental

DCI, established in 1977, offers integrated environmental services and solutions to a wide range of professional, industrial and government clientele across the country. DCI has completed 83 MGP soil and sediment site remedial efforts for 7 utility clients located in the Midwest, including the remediation of 2 MGP sites for the USEPA. DCI has General Contracted the major majority of its MGP sites, with regulatory oversight guidance provided by USEPA and State authorities. By combining civil construction, site remediation services, waste treatment technologies and value-added beneficial reuse programs, DCI is a dynamic and unique company. DCI's ability to combine these remediation and waste disposal technologies in a single service line reduces the client's liabilities and controls the spend in the site remediation process. Using technology-advanced systems and an endless dedication to quality, DCI's clients receive the most up-to-date site remediation and waste management services available.

Sevenson Environmental

Sevenson Environmental Services, Inc. (SES) has actively been involved in remedial construction since 1979 when they were selected as the principal contractor at the Love Canal site in Niagara Falls, New York. Sevenson's 30 years of remedial construction experience, coupled with 60 years of general construction experience, makes Sevenson one of the most experienced remedial construction firms in the environmental industry today. This experience enables Sevenson to effectively identify potential value-engineering opportunities, efficiently utilize manpower and equipment and provide safe, timely results within budget. Sevenson has successfully completed over 1,200 remedial action projects, valued at over $2.5 billion, including 100 Superfund sites for industry, government agencies and PRP groups. Extensive sediment remediation experience dates back to 1993 when Sevenson was awarded and successfully completed the first large-scale sediment remediation project (Hudson River) at a Superfund site at the Marathon Battery Site, Cold Springs, New York. Sevenson has continued to work on some of the nation's most visible sediment sites including the St. Lawrence River, Housatonic River, Fox River, Grasse River, Christina River, Pawtuxet River, and the Raisin River.

Sevenson Environmental has been designing, estimating, and installing sheet piling for over 30 years. In doing so, they have designed their own-patented system for sealing the interlock. Sevenson is recognized as the national leading remedial contractor managing contaminated sediments. They have completed some of the most difficult and complex sediment projects within the last 20 years. Sediment management projects such as Marathon Battery Superfund Site, Housatonic River, St. Lawrence River, West DuPage River, Frazier River, Cumberland Bay, Gasco, Fox River OU 56/57 and Phase 1 of the Fox River.

Several of the above listed projects included the design, installation and removal of sheeting in active waterways. In each case, Sevenson prepared the conceptual design and worked with a third party independent design engineer (PE) to verify the approach. The St. Lawrence River Project, Sevenson drove king piles and installed sheet piling around the entire work area.

* * * * *

APPENDIX B – June 2009 Oral Testimony

U.S. ENVIRONMENTAL PROTECTION AGENCY
WISCONSIN DEPARTMENT OF NATURAL RESOURCES
PROPOSED PLAN PUBLIC MEETING
ASHLAND/NORTHERN STATES POWER LAKEFRONT SITE
June 29, 2009, 7:00 p.m.

* *

A PUBLIC MEETING FOR THE
ASHLAND/NSP LAKEFRONT SUPERFUND SITE
TAKEN AT: NORTHERN GREAT LAKES VISITOR CENTER
29270 COUNTY HWY. G
ASHLAND, WISCONSIN 54806

TUESDAY, JUNE 29, 2009
7:00 p.m. to 8:20 p.m.

* *

SUSAN EDWARDS COURT REPORTING
5569 N Gade Road
Mercer, WI 54547
Phone: (715) 476-3484
(906) 362-4577 (cell)
sueedwards@centurytel.net

APPEARANCES:

MS. PATTI KRAUSE, EPA Community Involvement Coordinator, Environmental Protection Agency, 77 W. Jackson Blvd., Chicago, IL 60604.

MR. SCOTT HANSEN, EPA Remedial Project Manager, Environmental Protection Agency, 77 W. Jackson Blvd., Chicago, IL 60604.

MR. CRAIG MELODIA, Regional Counsel for U.S. Environmental Protection Agency.

Mr. JOHN ROBINSON, Northern Region Team Supervisor, Wisconsin Department of Natural Resources, 107 Sutliff Avenue, Rhinelander, WI 54501.

MR. HENRY NEHLS-LOWE, Wisconsin Department of Health, 1 W. Wilson Street, Madison, WI 53702.

MR. JAMIE DUNN, Project Manager, Wisconsin Department of Natural Resources, 810 W. Maple Street, Spooner, WI 54801.

MS. CONNIE ANTONUK, Wisconsin Department of Natural Resources.

MR. JOHN KOSLOWSKI, Wisconsin Department of Natural Resources.

* *

SPEAKERS PRESENTING PUBLIC COMMENTS:

MR. DAVE SORENSON, Citizens of Ashland
MR. LOWELL MILLER, Former Mayor of City of Ashland
MR. DAVE MARTINSON, Ashland Business Alliance
MS. SANDRA DUNNE, Self and League of Women Voters
MR. ED MONROE, Mayor of City of Ashland
MR. DAVID DONOVAN, Northern States Power, Wisconsin
MR. DAVE TRAINOR, Xcel Energy (d/b/a NSPW)
MR. DEAN STOCKWELL, URS Corporation
MR. HUBERT HULS, URS Corporation
MR. FRANK KELLOGG, DCI Environmental
MR. LARRY MILNER, Seversen Environmental
MR. MIKE CRYSTAL, Burns & McDonnell

(Tuesday, June 29, 2009, 7:00 p.m.,
Northern Great Lakes Visitor Center.)

MS. PATTI KRAUSE: Thank you for coming out tonight, and we look forward to presenting much as the EPA preferred alternative. Thank you.

MS. PATTI KRAUSE: Our next speaker is Frank Kellogg. And, Frank, if you could give your name and spell it, please.

MR. FRANK KELLOGG: Good evening, ladies and gentlemen. My name is Frank Kellogg, Kellogg like the cereal, K-E-L-L-O-G-G, and currently I represent DCI Environmental Company. I represent a team, a team consisting of DCI Environmental, Larry Milner from Burns McDonnell, and Mike Crystal from Sevenson Environmental.

This team particularly was assembled -- and by the way -- we're not currently on a payroll; however, our experience is what the intent is here today to deliver, and that is, collectively we had remediated and/or been on over 300 manufactured gas plant site efforts around the country and over three dozen sediment remediation sites as they pertain to manufactured gas plant waste.

With that, it is constructive input. We are not here to say exactly how to get the project done, as much as though hearing as many of our other clients, constituents, of a utility

company in which rate payers do bear the cost of these remedial efforts around the country, you are not alone.

Our mantra and our vision we are delivering here is to put together a design thought process in order to hopefully be involved in the project when the project comes to a remedial phase that consists of protection of human health and the environment, one.

Two, safety, safety of people. People outside of the project boundaries, as well as people inside of the project boundaries.

And thirdly, and equally as important, cost parameters. That as we understand, particularly today with the economic times of society, the importance of delivering the like product as to what EPA has recommended but at a lesser cost.

What I would like to do is I would like to turn it over to Mr. Larry Milner of Burns McDonnell, and he will take you through some issues followed by Mike Crystal.

MR. LARRY MILNER: Thanks again. My name is Larry Milner, M-I-L-N-E-R, of Burns McDonnell. First, what I want to talk about is

because of the artesian conditions in the Copper Falls Aquifer, calculations indicate that under dry dredge conditions, the uplift will be greater than the downward pressure at the bay area.

Now that creates a couple of issues, and those issues are -- No. 1, that free product that's been talked about earlier, will have a tendency to be pulled towards the bay. It is not a good situation.

No. 2, we will also have upwelling in the dredging area itself. And the upwelling is what we are really going to focus on right now, and we have a short animation that we want to show you that shows you what could happen under dry dredge conditions if there was upwelling and basically potential failure of the sheet pile wall.

MR. MIKE CRYSTAL: Hi. I am Mike Crystal of Seversen, C-R-Y-S-T-A-L. I am the vice president of operations with several years of experience on several sites going back over 30 years.

And sheet piling the water, our company probably started doing some of the biggest projects doing this type of work 15 years ago.

So with that, we're going to show you an animation and show you what we think is going to happen.

Basically this is just an animation showing what you have out there, where the marina is, and you talk about sheet piling. The sheet piling is these long pieces of steel. You have to realize that you are talking a single wall here that is going to be cantilevered in.

So for every section you see up, the rule of thumb is one-third up/two-thirds below. These sheets ended up being 40 or 50-foot in design. One of the problems is that they may break into the Miller Creek, which is going to give you the possible potential of upbringing.

When you talk about going into the dry, this is actually dry. This is not really what you would see, but you would see a real wet silty material. Here you can see the break-through that could happen. There is a big possibility of failure in this wall.

We have done probably six months review on, you know, the constructability and cost estimating. A single wall here will not work, and what we're concerned about is, I don't think

you will get to the ice. You are going to have wave action and force from the Great Lakes.

Has anybody ever seen six or eight-foot waves out there? I mean that could be putting alot of force on there, and we have had engineering companies look at this from a feasibility, constructability standpoint. I don't think you can get a wall in that will hold the force.

The other thing is in the EPA proposed plan, you have to look at the debris and the level of effort. Driving a sheet into the ground may be one thing, you know, but driving it through wood and debris, you know, there will be alot of debris removal, containment. And what we think is under this EPA preferred method that you are talking right now, a cost difference that could be in the $10 million to $20 million range, but that could be off by a factor of as much as two. So it is not just a cost to us.

You have two or three things that you should look at in this scenario. One is if we drive a sheet down, if we go through that protective barrier, you know, is that going to be a pathway if it is mobilized for it to come into

the bay?

The second thing is looking at the forces involved, even if you are 200 feet off, or whatever, that you are going to have with waves and wind action, ice, this stuff will have to be pulled every fall and be reinstalled.

So the project the way it was set up and the way we understood it, you know, it is going to be alot longer and it is going to be alot more expensive.

MR. LARRY MILNER: You might think we are just kind of speculating on this, but we do have a couple of pictures that we want to show you. This is an excavation over in Dubai, near the marina, and you can see down in the corner over here, you can see the water breaking through the wall, and I am going to just show you what can happen.

You can see water coming in, and then all of a sudden, wall failure. I mean, these things do happen, you know, it is not unrealistic. We really think that you are going to have problems with this single sheet wall. So we think the cost to really do it right, we believe is going to be alot more than what is in

the FS right now.

The next picture here is one that kind of shows a little bit of an upwelling. This is an NVP site in Chicago, near the Chicago River.

If you can see this before, where we dug down, left that night, came back, and when we came back in, water had started to fill up in the excavation. And by the time it was roughly around noon, you can see the equipment completely flooded. Now this was being done in a small dam area, so we were able to come back in and deal with that with pumping and stuff.

But just imagine if you have upwelling in a 12 to 14-acre area, you are not going to be able to de-water that. In this case we were able to do it, but in a case like here, it is not going to work.

Frank, do you want to close it?

MR. FRANK KELLOGG: The good news is that as specified, the current thought behind the FS wall design is fixable, but it is fixable at anywhere between a 15 to 25 million dollar delta at the end of the day.

However, we do currently believe that what we can achieve in the wet dredging

application is achievable. The wall is fixable. The upheaval is an unknown. And nobody could look at us in the field, going out and employing the work, with a straight face and say: That upheaval will not occur.

So with that, consideration of the final remedy, protection of human health and the environment -- again, to reiterate my thought. I thought I covered it.

That wall is fixable. The upheaval in our opinion currently is not fixable. We are here to say that at the end of the day through our vast experience in manufactured gas plant site remediations around the country, coupled with our sediment experience, when working within tar, the end goal is of achievability of protection of human health and the environment, of safety, you know.

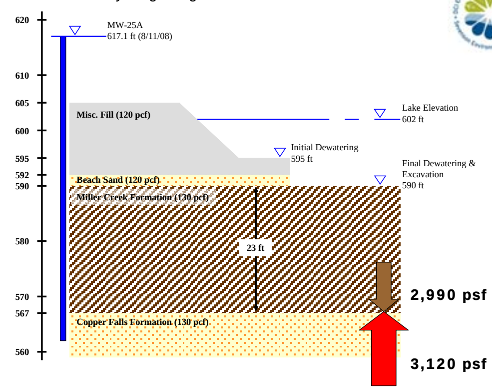
Mr. Trainor spoke briefly, and I believe the gentleman from URS did as well, about odor issues. That coupled with the fact that we can achieve that end point in a wet dredge application should certainly be considered, but equally said, our primary goal as we have talked collectively amongst the team, was if this

project comes forward in the current state of an FS, we consider ourselves to be one of the top collective teams with the most experience, would we propose on a current FS design?

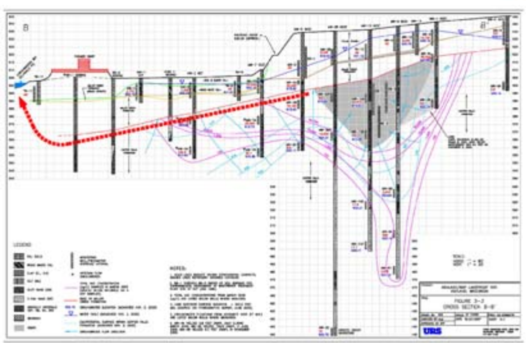
The answer quite candidly is no, because we are equally -- what is more important than the money, is certainly the safety of all people involved in the job, and at the end of the day if we can deliver the product at a cost that is considerably less than what a dry dredge application would be, that should be the name of the game here. At the end of the day, not including the fact that you are looking at about a two-year delta from wet to dry at the same time and project duration.

Constructive Input of Dry Dredge USEPA Remedy Selection

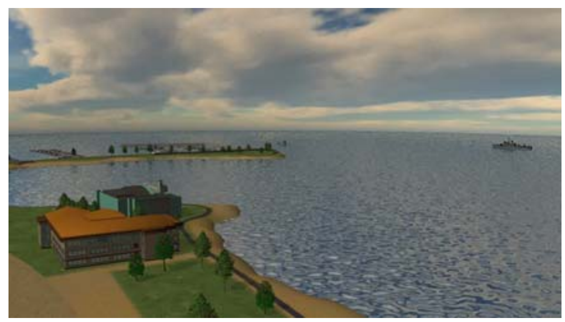
Hydrogeologic Cross Section Condition



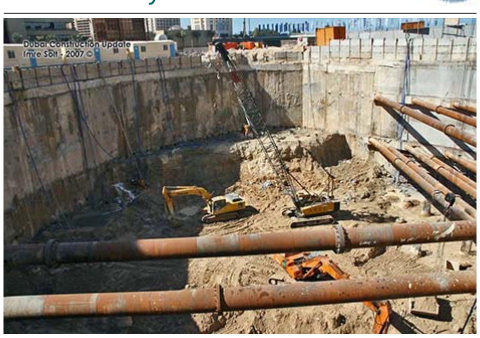
Possible Condition



Dry Dredge Animation



Example #1: Wall Failure
Dubai Infinity Tower



Example #1: Wall Failure
Dubai Infinity Tower

Example #1: Wall Failure
Dubai Infinity Tower

Example #1: Wall Failure
Dubai Infinity Tower

Example #2: Basal Heave Failure
Chicago, IL

Example #2: Basal Heave Failure
Chicago, IL

Example #2: Basal Heave Failure
Chicago, IL

Example #2: Basal Heave Failure
Chicago, IL

Constructive Input of Dry Dredge USEPA Remedy Selection

APPENDIX C – Basal Heave References

DRAFT Memorandum

June 1, 2009

TO: Jerry Winslow, Northern States Power Company

CC: Nick Azzolina, Steve Laszewski

FR: Jerry Eykholt, Jim Hutchison

RE: Preliminary Geotechnical Review – Sheet Pile Wall Installation for the Ashland/NSPW Lakefront Site

Background

This memorandum provides Foth's comments on the risks associated with basal heave failure and other geotechnical structural design elements for the two predominant sediment removal options for the Ashland/Northern States Power Company (NSPW) Lakefront Site. These two options currently include:

- Alternative SED-4B, removal by mechanical dredging, dewatering and off-site disposal (wet dredge), and
- Alternative SED-6B, hybrid remedy of a) excavation in the dry behind sheet pile using shore-based excavation techniques and equipment, and b) mechanical dredging for contaminated sediment further from the shore.

The sediment at the Site is underlain by the Miller Creek clay formation, which acts as an aquitard. There are known artesian conditions beneath the aquitard in the Copper Falls aquifer. Therefore, under certain removal conditions, uplift pressures from the artesian conditions at the base of the aquitard will exceed the overburden pressures. If the uplift forces that are not counter-balanced by overburden forces, then failure can result (basal heave failure), with risk to construction, project safety, and containment of contaminated sediments.

Foth has conducted an independent, preliminary geotechnical analysis and has generated a series of figures that reinforce and extend the calculations provided by AECOM.

Estimated Stresses for Initial Conditions and the Two Removal Options

For the simplest evaluation of basal heave, total downward vertical stresses on the base of the aquitard are compared to the uplift pressure. For the cases considered here, the uplift pressure is

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the pore pressure provided by the artesian head. The assumed geologic profile, total stresses and pore water pressures are shown in Figure 1.

The effective stress is the total vertical stress (from overburden) minus the pore pressure. Therefore, when the effective stress is negative, pore pressures are greater than overburden and there is the potential for uplift or a basal heave failure. The magnitude of negative effective stresses is largest for a dry/hybrid removal case at the top of the aquitard (elev. 590 ft.), at -750 psf (pounds per square foot), but are negative throughout the entire aquitard thickness. Immediately after removal, the clay cannot drain freely and pore pressures from the initial state would remain. This type of pore pressure-effective stress consideration is called the "undrained state", and it is often found to be a critical state in a more complete analysis of geotechnical stability.[1]

The situation of negative effective stresses over the whole aquitard causes concern with regard to basal failure. In contrast, the wet dredge removal scenario (SED-4B) yields a positive effective stress throughout the aquitard.

The severity of the unloading condition on the stability of the top of the aquitard depends on several factors, including the stiffness (shear strength), geometric factors related to the configuration of the excavation, and the hydraulic conductivity of the aquitard.

As mentioned above, the result of a negative effective stress at the top of the aquitard for the hybrid removal option is not unexpected. This result would occur even without artesian conditions, as is shown in Figure 2. Here, the head at the base of the aquitard is set at the lake elevation, and the pore pressure at the base of the aquitard is 2184 psf, nearly 1000 psf lower than the artesian condition. The effective stress at the top of aquitard is the same (-750 psf), but effective stresses increase to positive values at depth within the aquitard.

The factor of safety against basal heave failures was calculated for various values of aquitard thickness and unit weights (sediment and aquitard density) and plotted by AECOM. With the factor of safety defined as the ratio of the overburden stress to the porewater pressure at the base of the aquitard, Foth has reproduced the calculations and plotted curves for the same conditions. The result is shown in Figure 3. The overall agreement between the Foth calculations and the AECOM plot is good.

<u>Discussion on Need for More Advanced Geotechnical Analysis for Wet and Dry Sediment Removal</u>

Additional sediment and subgrade geotechnical characteristic data across the site could occur this summer, but should also include a basic framework of:

- Engage the agencies in the planning and evaluation of the key geotechnical issues,
- If new data are needed, include needs in a future work plan,

[1] Drained unloading, which would occur at the top of the aquitard after enough time is provided to relieve pore pressures, generally produces higher effective stresses.

- Conduct preliminary structural sheet pile design of removal alternatives prior to new data collection, and
- Present findings to agencies prior to ROD release

These new data can be collected using standard drilling techniques.

Any work plan for collecting these data should incorporate the need to confirm the issues related to basal heave risks (aquitard thickness, consistency and stability) as well as sediment and subgrade geotechnical characteristics associated with wet removal of sediment.

The AECOM plot shows a suitable range for factors of safety for basal heave to be 1.2 to 1.4, and that the aquitard thickness should be greater than ~35 feet for the safe conditions. The preliminary analysis and simple definition for basal stability is useful for identifying a potential problem. However, a more complete geotechnical analysis is needed to quantify factors such as shear strength of the aquitard and geometric factors related to the configuration of the excavation.

In addition to the basal failures from uplift, the presence of sand seams, cracks, or other conductive hydraulic features in the aquitard may cause seepage problems for various removal options. As with basal heave failures, the most difficulty is expected for the dry removal option, for which pressure gradients between the top and bottom of the aquitard are likely to be the highest.

Specific geotechnical data needs obtained from existing data, which may be used in the preliminary design should consist of the following:

- all available data on aquitard thickness and artesian head over site area,
- elevations of existing sediment, post-dredge sediment, top of aquitard,
- shear strength testing data on aquitard material,
- blow counts from available logs in area,
- review of any existing shear strength data on sands and aquitard clay materials, and
- careful review of boring logs over area for any presence of sand, cracks or other conductive features in the clay aquitard.

New data collection from borings could include:

- elevations of top of sediment and top and bottom of aquitard material,
- blow count and moisture content data with depth,
- shear strength data with depth of different strata encountered by the borings, and
- gradation, permeability and consolidated undrained shear strength data with depth.

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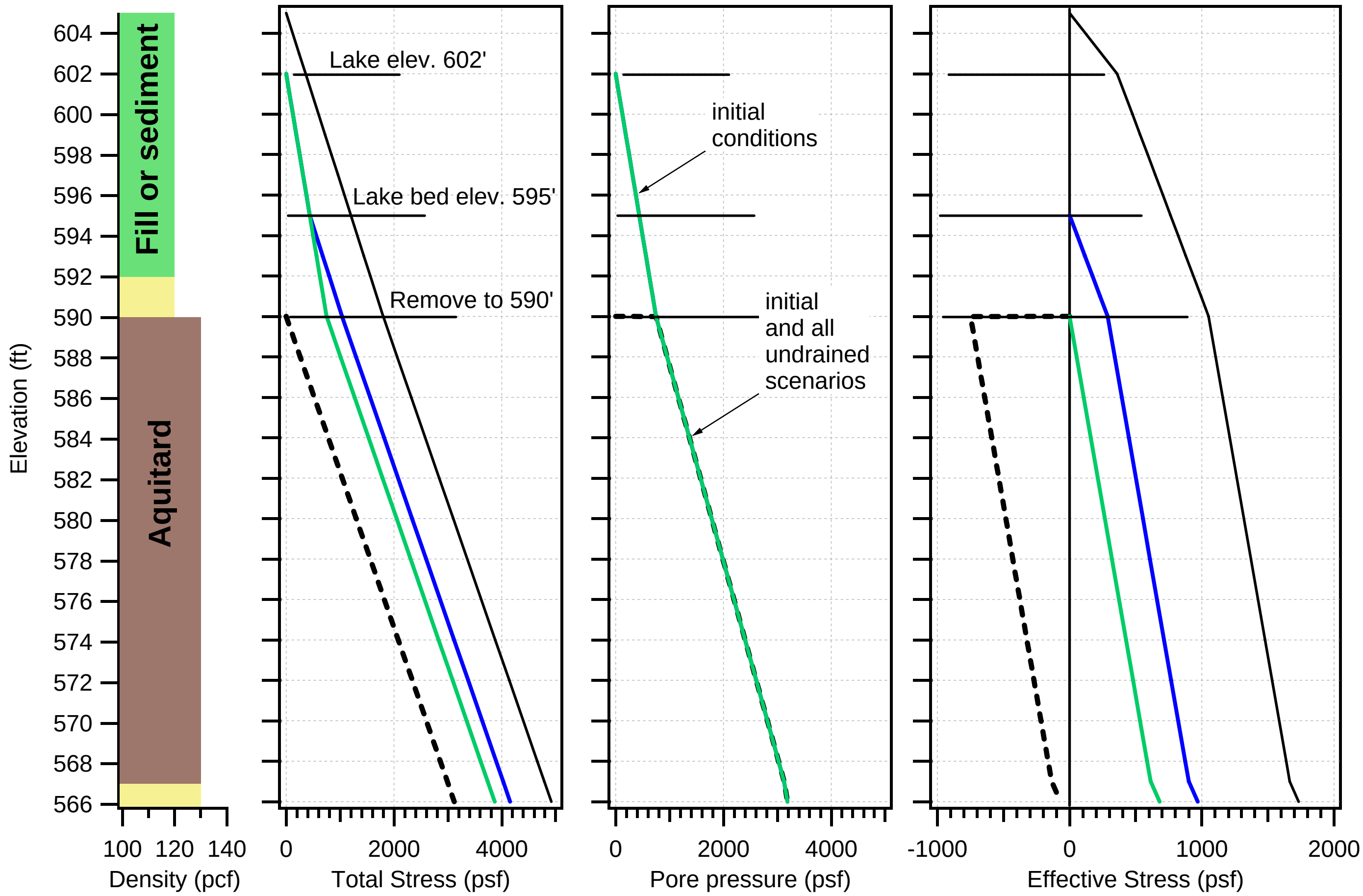
Summary

A preliminary analysis of the potential for a basal heave failure has indicated that the dry removal option may result in a stress condition that is unstable. In particular, due to artesian conditions, the pore pressures may exceed the overburden pressures at the base of the aquitard. Since a basal failure during excavation carries significant safety and project risks, it may be prudent to remove from consideration this alternative from actively promoted remediation alternatives going forward.

In addition, other factors that affect basal stability, such as the shear strength of the aquitard clays and geometric factors associated with potential failure conditions may be considered in a more advanced analysis, if required. Further analyses should include review of historical and site geotechnical information (such as aquitard thickness, evidence of shear strength of the aquitard, and artesian heads) and possibly additional site borings.



Notes:

1. Assumes artesian conditions at base of aquitard.
   Head = 617.1 ft.
   pore water pressure = (62.4 pcf) (617.1 - 567 ft) = 3126 psf.

2. Assumes initial pore pressures in aquitard are in equilibrium.

3. Undrained cases assume that pore pressures in aquitard do not change.

Scenarios:

Initial Conditions
A1: Land surface at Elev 605'
A2: In bay, sediment surface at 595'

Post-removal conditions (undrained)
B2: in bay, after dry excavation to 590'
B3: After dredging to 590' (wet removal)

DRAFT

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XCEL ENERGY

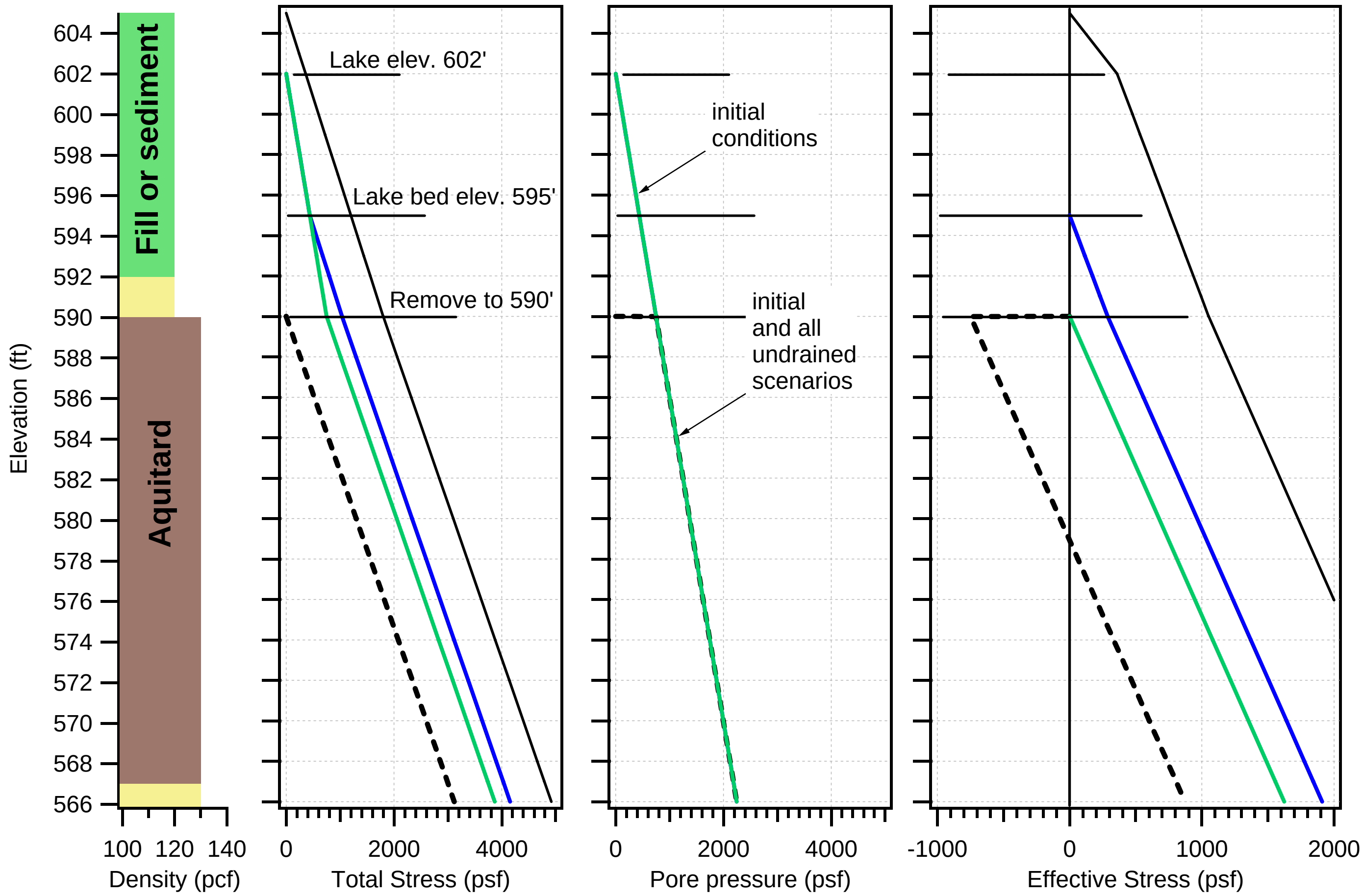
FIGURE 1

ASHLAND PROJECT
ESTIMATED EFFECTIVE STRESSES IN MILLER CREEK AQUITARD WITH VARIOUS REMOVAL SCENARIOS

Scale: AS SHOWN	Date: MAY 2009

Drawn By: GRE	Checked By: JBM	Scope: 09X001

X: \GB\IE\2009\09X001\12000 data & calcs\IGR\Eff_Stress_Analysis.pxp



Notes:

1. Assumes artesian conditions removed at base of aquitard.
   Head = 602 ft.
   pore water pressure = (62.4 pcf) (602 - 567 ft) = 2184 psf.

2. Assumes initial pore pressures in aquitard are in equilibrium.

3. Undrained cases assume that pore pressures in aquitard do not change.

Scenarios:

Initial Conditions
A1: Land surface at Elev 605'
A2: In bay, sediment surface at 595'

Post-removal Conditions
B2: in bay, after dry excavation to 590'
B3: After dredging to 590' (wet removal)

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FIGURE 2

ASHLAND PROJECT
ESTIMATED EFFECTIVE STRESSES IN MILLER CREEK AQUITARD WITH REMOVAL OF ARTESIAN CONDITION

Scale: AS SHOWN		Date: MAY 2009	
Drawn By: GRE	Checked By: JBM	Scope: 09X001	

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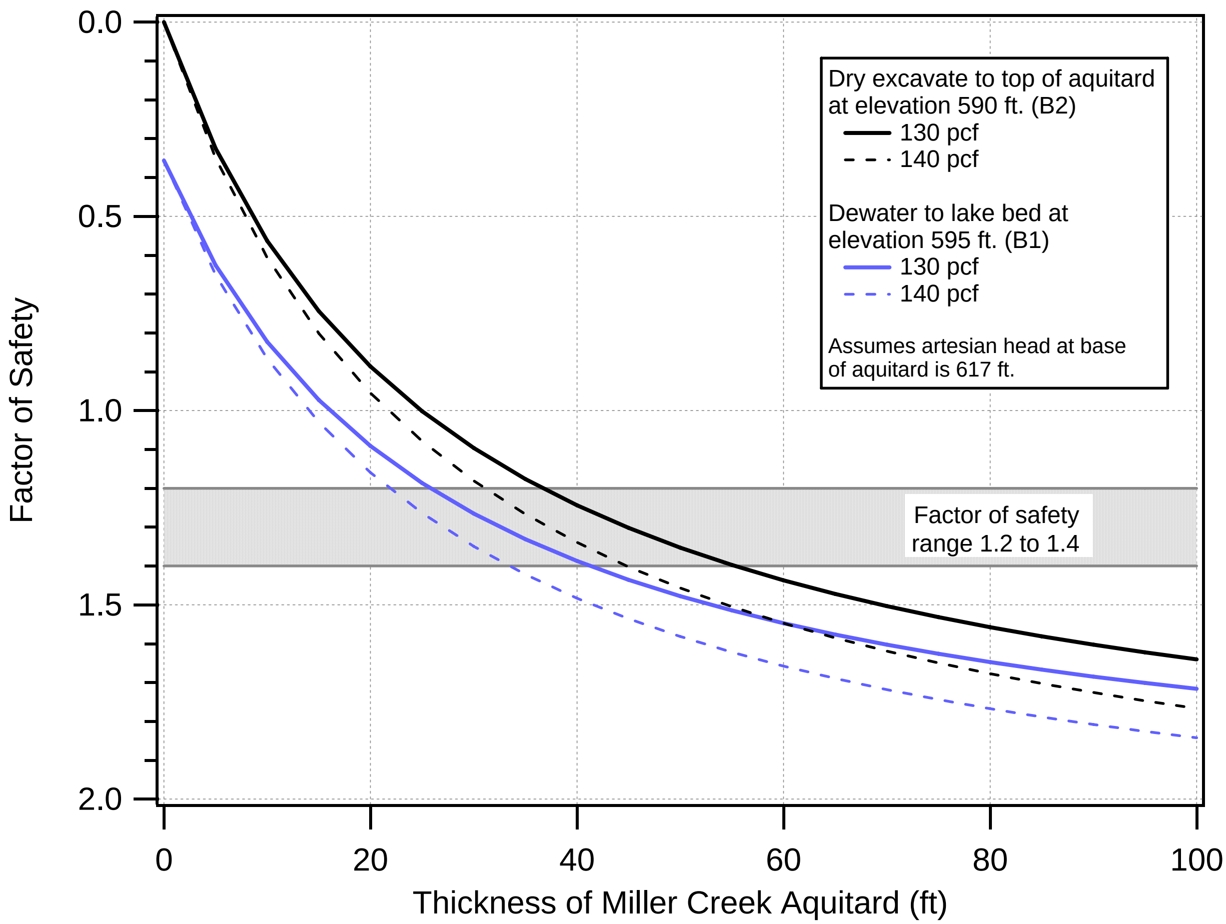

Notes:

1. Factor of safety is for simple basal heave, the ratio of total vertical overburden pressure to artesian pressure at base of the aquitard.

   Example calculation (dry excavation case):

   Aquitard thickness = 37 ft., unit weight = 130 pcf
   Elevation at base of aquitard = 553 ft.

   overburden pressure = (37 ft.) (130 pcf) = 4810 psf
   artesian pressure = (617 - 553 ft) (62.4 pcf) = 3994 psf

   FS = 4810 psf / 3994 psf = 1.20

2. Analysis does not consider resistance to basal heave due to shear strength of aquitard clay, and it ignores geometric effects of potential failure surfaces. Analysis should be considered as preliminary.

3. Other failure mechanisms not considered here, such as from piping.

4. Figure is an independent analysis and check of analysis provided by AECOM, received by Foth on 5/21/09. The agreement is excellent.

DRAFT

Foth Infrastructure & Environment, LLC

XCEL ENERGY

FIGURE 3

ASHLAND PROJECT
PRELIMINARY ANAYSIS OF BASAL HEAVE
FAILURE FACTORS OF SAFETY FOR AQUITARD

Scale: AS SHOWN		Date: MAY 2009	
Drawn By: GRE	Checked By: JBM	Scope: 09X001	

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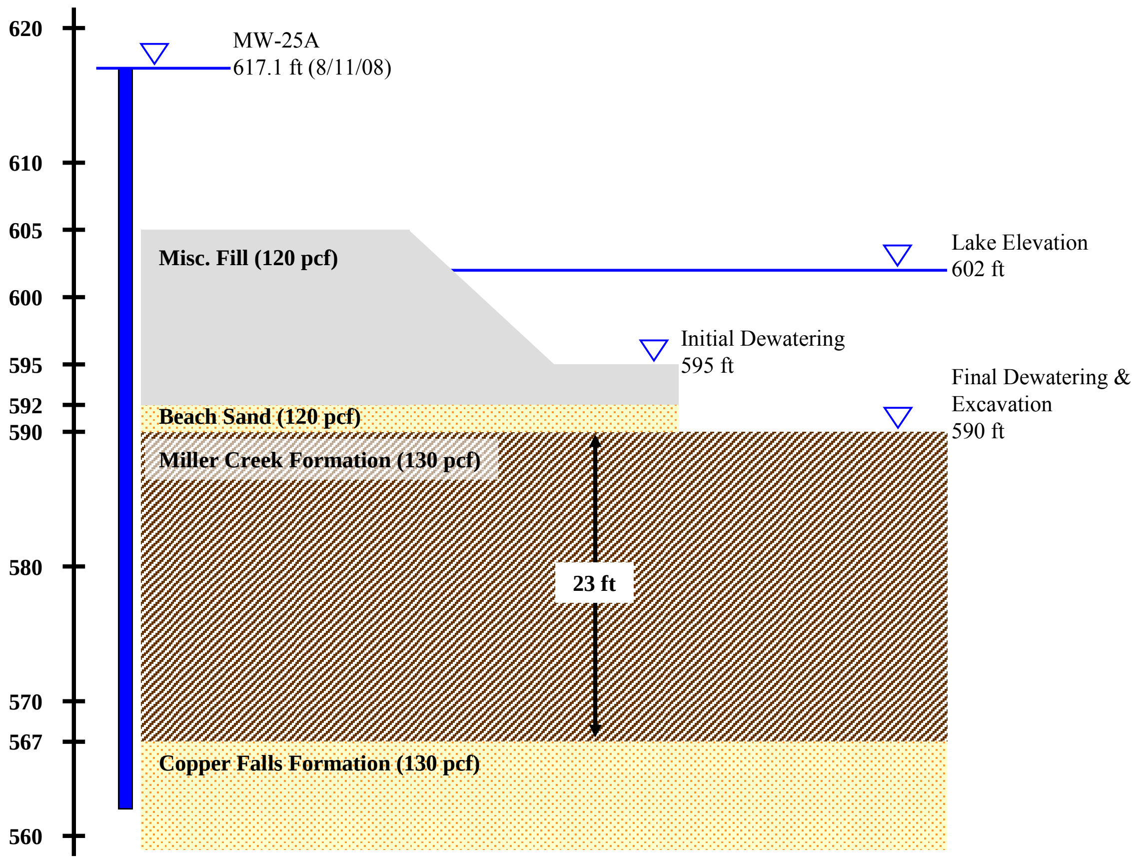
Ashland/NSPW Lakefront Site

Hydrogeologic Cross Section and Evaluation of Effective Stress, as depicted in the Technical Work Group Meeting in Madison, WI on May 29, 2009.



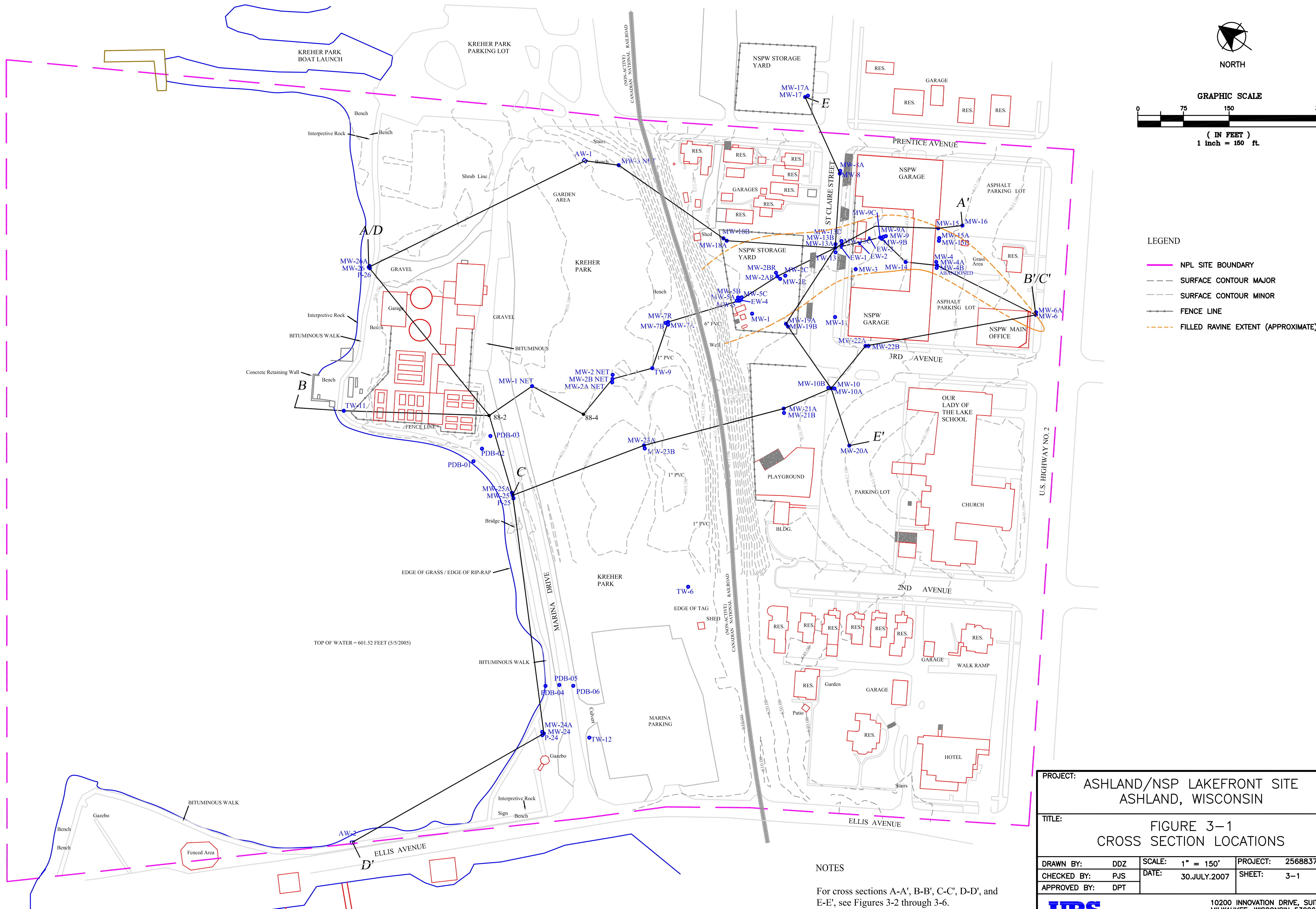
After final dewatering and excavation:

Downward Force (D↓) = (590 ft – 567 ft) x 130 lb/ft^3
= 23 ft x 130 lb/ft^3
= 2,990 lb/ft^2

Artesian Force (H↑) = (617 ft – 567 ft) x 62.4 lb/ft^3
= 50 ft x 62.4 lb/ft^3
= 3,120 lb/ft^2

Effective Stress = D↓ − H↑
= 2,990 lb/ft^2 − 3,120 lb/ft^2
= **-130 lb/ft^2**

Artesian Force > Downward Force => Basal heave failure



PROJECT: ASHLAND/NSP LAKEFRONT SITE
ASHLAND, WISCONSIN

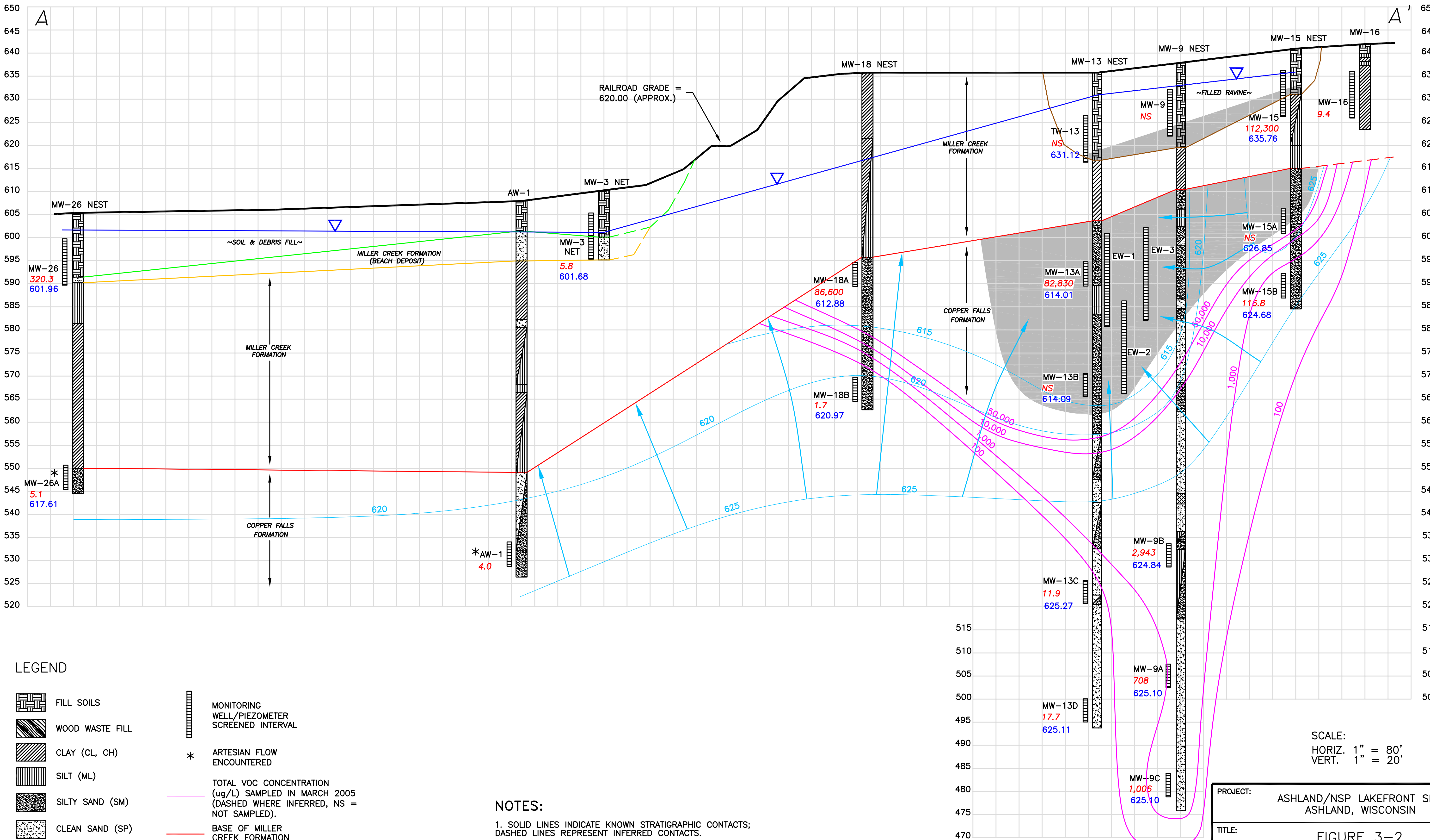
TITLE: FIGURE 3–1
CROSS SECTION LOCATIONS

DRAWN BY:	DDZ	SCALE:	1" = 150'	PROJECT:	25688375
CHECKED BY:	PJS	DATE:	30.JULY.2007	SHEET:	3–1
APPROVED BY:	DPT				

URS
10200 INNOVATION DRIVE, SUITE 500
MILWAUKEE, WISCONSIN 53226
414–831–4100

NOTES

For cross sections A-A', B-B', C-C', D-D', and E-E', see Figures 3-2 through 3-6.



LEGEND

FILL SOILS

WOOD WASTE FILL

CLAY (CL, CH)

SILT (ML)

SILTY SAND (SM)

CLEAN SAND (SP)

GRAVELLY INTERVALS (GP, GM, GC, SW)

BEDROCK

DNAPL

MONITORING WELL/PIEZOMETER SCREENED INTERVAL

* ARTESIAN FLOW ENCOUNTERED

TOTAL VOC CONCENTRATION (ug/L) SAMPLED IN MARCH 2005 (DASHED WHERE INFERRED, NS = NOT SAMPLED).

BASE OF MILLER CREEK FORMATION

602.10 GROUNDWATER ELEVATION (MEASURED NOV. 3, 2005)

WATER TABLE (MEASURED NOV. 3, 2005)

EQUIPOTENTIAL SURFACE WITHIN COPPER FALLS FORMATION (MEASURED NOV. 3, 2005)

GROUNDWATER FLOW DIRECTION

NOTES:

1. SOLID LINES INDICATE KNOWN STRATIGRAPHIC CONTACTS; DASHED LINES REPRESENT INFERRED CONTACTS.

2. TOTAL VOC CONCENTRATIONS FROM MARCH 2005 (ug/L) ARE LISTED BELOW WELLS WHERE ANALYZED.

3. STRATIGRAPHY FOR AW-1 FROM GEOPHYSICAL SURVEY COMPLETED BY GEOSPHERE, INC. (NOVEMBER 2005).

4. GROUNDWATER ELEVATIONS FROM NOVEMBER 2005 (FT MSL) ARE LISTED BELOW WELLS WHERE MEASURED.

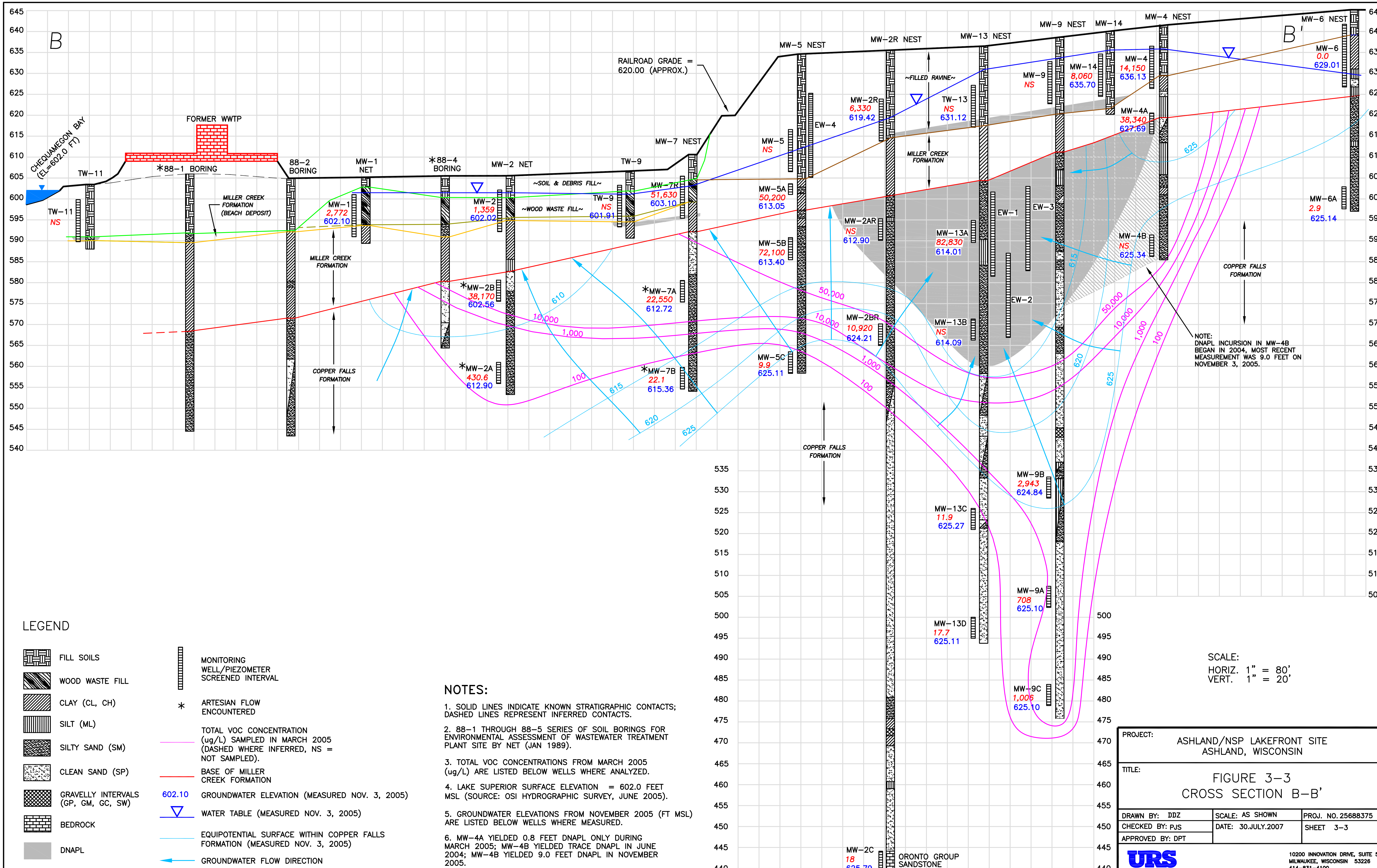
SCALE:
HORIZ. 1" = 80'
VERT. 1" = 20'

PROJECT:	ASHLAND/NSP LAKEFRONT SITE ASHLAND, WISCONSIN
TITLE:	FIGURE 3-2 CROSS SECTION A-A'

DRAWN BY: DDZ	SCALE: AS SHOWN	PROJ. NO. 25688375
CHECKED BY: PJS	DATE: 30.JULY.2007	SHEET 3-2
APPROVED BY: DPT		

URS

10200 INNOVATION DRIVE, SUITE 500
MILWAUKEE, WISCONSIN 53226
414-831-4100



LEGEND

- FILL SOILS
- WOOD WASTE FILL
- CLAY (CL, CH)
- SILT (ML)
- SILTY SAND (SM)
- CLEAN SAND (SP)
- GRAVELLY INTERVALS (GP, GM, GC, SW)
- BEDROCK
- DNAPL
- MONITORING WELL/PIEZOMETER SCREENED INTERVAL
- * ARTESIAN FLOW ENCOUNTERED
- TOTAL VOC CONCENTRATION (ug/L) SAMPLED IN MARCH 2005 (DASHED WHERE INFERRED, NS = NOT SAMPLED).
- BASE OF MILLER CREEK FORMATION
- 602.10 GROUNDWATER ELEVATION (MEASURED NOV. 3, 2005)
- WATER TABLE (MEASURED NOV. 3, 2005)
- EQUIPOTENTIAL SURFACE WITHIN COPPER FALLS FORMATION (MEASURED NOV. 3, 2005)
- GROUNDWATER FLOW DIRECTION

NOTES:

1. SOLID LINES INDICATE KNOWN STRATIGRAPHIC CONTACTS; DASHED LINES REPRESENT INFERRED CONTACTS.
2. 88-1 THROUGH 88-5 SERIES OF SOIL BORINGS FOR ENVIRONMENTAL ASSESSMENT OF WASTEWATER TREATMENT PLANT SITE BY NET (JAN 1989).
3. TOTAL VOC CONCENTRATIONS FROM MARCH 2005 (ug/L) ARE LISTED BELOW WELLS WHERE ANALYZED.
4. LAKE SUPERIOR SURFACE ELEVATION = 602.0 FEET MSL (SOURCE: OSI HYDROGRAPHIC SURVEY, JUNE 2005).
5. GROUNDWATER ELEVATIONS FROM NOVEMBER 2005 (FT MSL) ARE LISTED BELOW WELLS WHERE MEASURED.
6. MW-4A YIELDED 0.8 FEET DNAPL ONLY DURING MARCH 2005; MW-4B YIELDED TRACE DNAPL IN JUNE 2004; MW-4B YIELDED 9.0 FEET DNAPL IN NOVEMBER 2005.

PROJECT:	ASHLAND/NSP LAKEFRONT SITE ASHLAND, WISCONSIN
TITLE:	FIGURE 3-3 CROSS SECTION B-B'

DRAWN BY: DDZ	SCALE: AS SHOWN	PROJ. NO. 25688375
CHECKED BY: PJS	DATE: 30.JULY.2007	SHEET 3-3
APPROVED BY: DPT		

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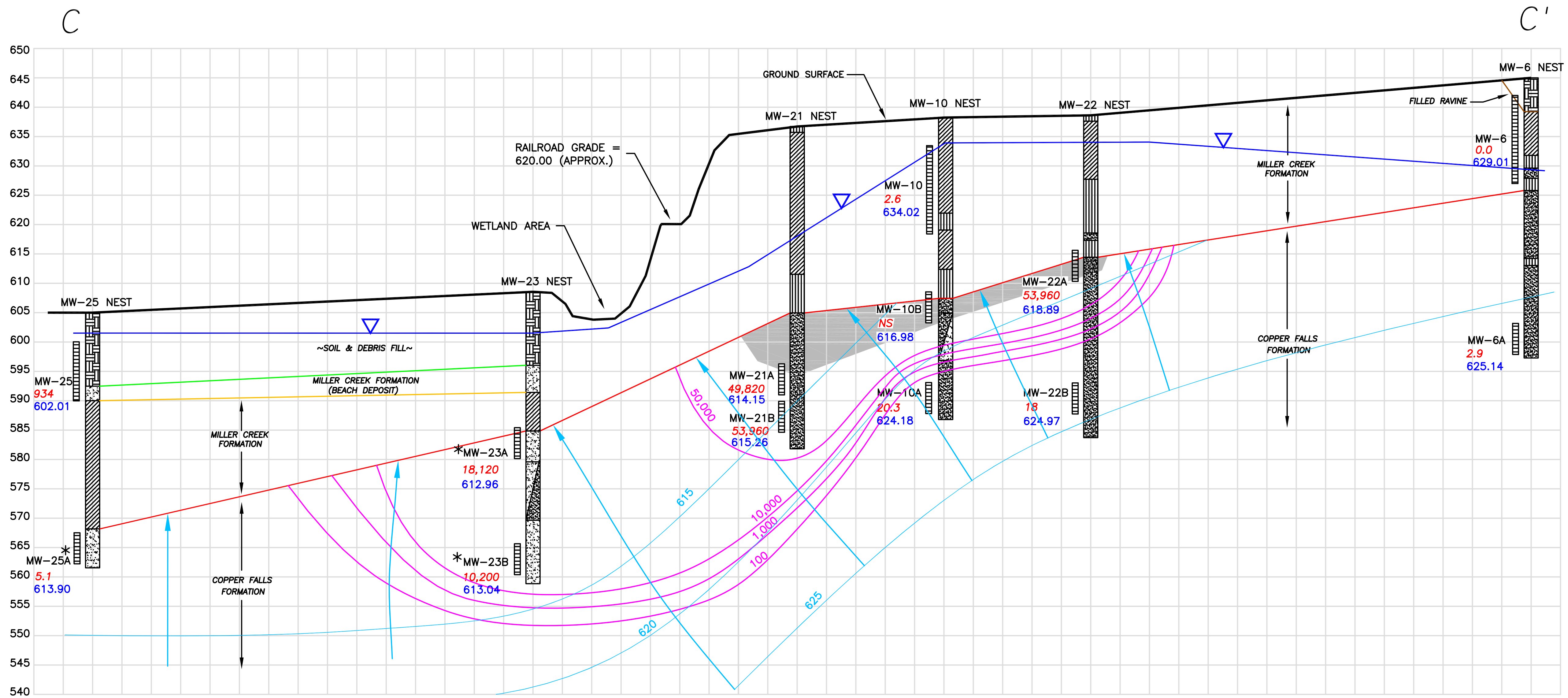
414-831-4100



LEGEND

- FILL SOILS
- WOOD WASTE FILL
- CLAY (CL, CH)
- SILT (ML)
- SILTY SAND (SM)
- CLEAN SAND (SP)
- GRAVELLY INTERVALS (GP, GM, GC, SW)
- BEDROCK
- DNAPL
- MONITORING WELL/PIEZOMETER SCREENED INTERVAL
- * ARTESIAN FLOW ENCOUNTERED
- TOTAL VOC CONCENTRATION (ug/L) SAMPLED IN MARCH 2005 (DASHED WHERE INFERRED, NS = NOT SAMPLED).
- BASE OF MILLER CREEK FORMATION
- 602.10 GROUNDWATER ELEVATION (MEASURED NOV. 3, 2005)
- WATER TABLE (MEASURED NOV. 3, 2005)
- EQUIPOTENTIAL SURFACE WITHIN COPPER FALLS FORMATION (MEASURED NOV. 3, 2005)
- GROUNDWATER FLOW DIRECTION

NOTES:

1. SOLID LINES INDICATE KNOWN STRATIGRAPHIC CONTACTS; DASHED LINES REPRESENT INFERRED CONTACTS.
2. TOTAL VOC CONCENTRATIONS FROM MARCH 2005 (ug/L) ARE LISTED BELOW WELLS WHERE ANALYZED.
3. GROUNDWATER ELEVATIONS FROM NOVEMBER 2005 (FT MSL) ARE LISTED BELOW WELLS WHERE MEASURED.

SCALE:
HORIZ. 1" = 80'
VERT. 1" = 20'

PROJECT:	ASHLAND/NSP LAKEFRONT SITE ASHLAND, WISCONSIN
TITLE:	FIGURE 3–4 CROSS SECTION C–C'

DRAWN BY: DDZ	SCALE: AS SHOWN	PROJ. NO. 25688375
CHECKED BY: PJS	DATE: 30.JULY.2007	SHEET 3–4
APPROVED BY: DPT		

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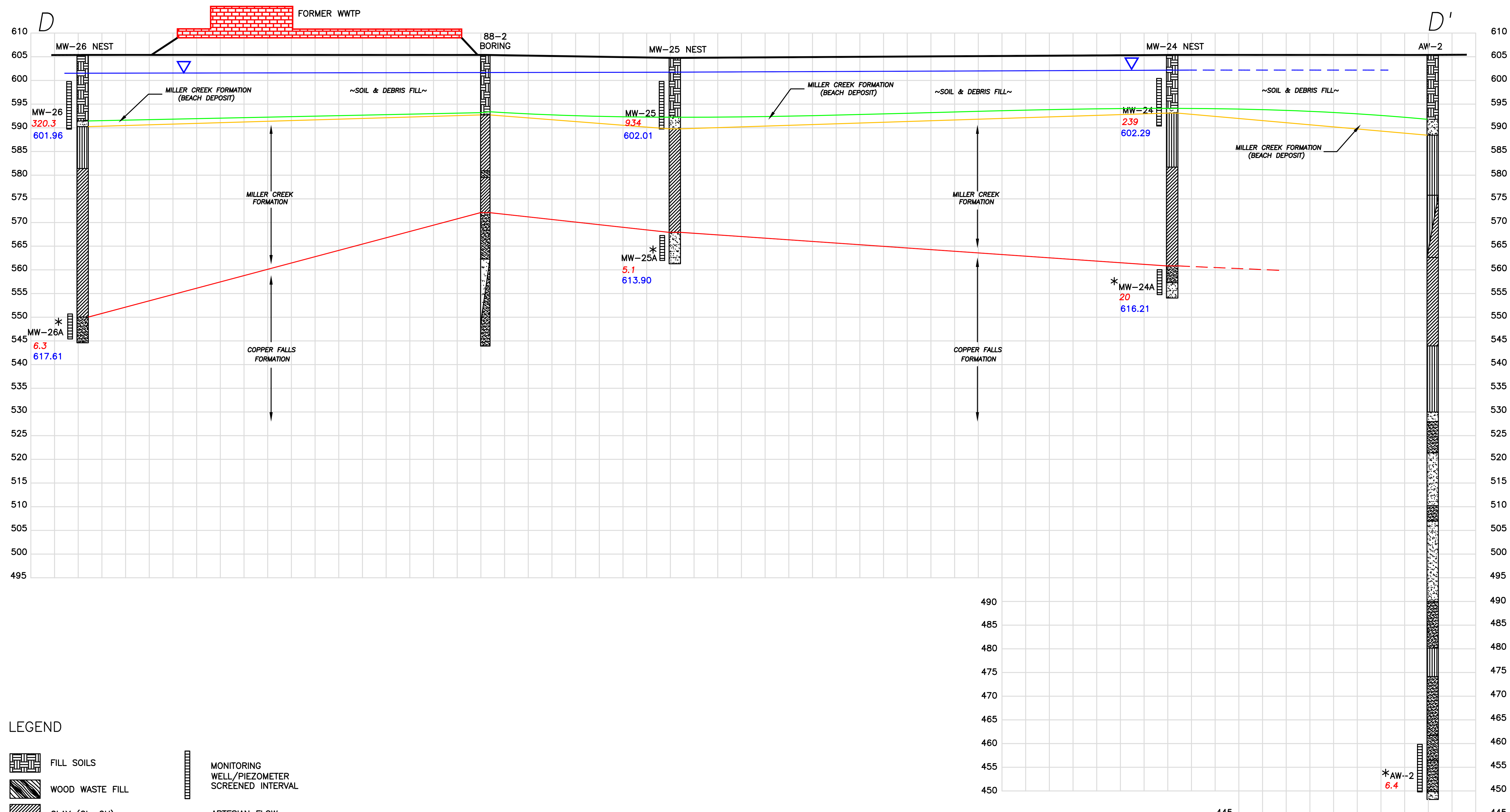
MILWAUKEE, WISCONSIN 53226
414–831–4100



LEGEND

- FILL SOILS
- WOOD WASTE FILL
- CLAY (CL, CH)
- SILT (ML)
- SILTY SAND (SM)
- CLEAN SAND (SP)
- GRAVELLY INTERVALS (GP, GM, GC, SW)
- BEDROCK
- MONITORING WELL/PIEZOMETER SCREENED INTERVAL
- * ARTESIAN FLOW ENCOUNTERED
- TOTAL VOC CONCENTRATION (ug/L) SAMPLED IN MARCH 2005 (DASHED WHERE INFERRED, NS = NOT SAMPLED).
- BASE OF MILLER CREEK FORMATION
- WATER TABLE (MEASURED NOV. 3, 2005)
- 617.61 GROUNDWATER ELEVATION (MEASURED NOV. 3, 2005)

NOTES:

1. SOLID LINES INDICATE KNOWN STRATIGRAPHIC CONTACTS; DASHED LINES REPRESENT INFERRED CONTACTS.
2. 88-1 THROUGH 88-5 SERIES OF SOIL BORINGS FOR ENVIRONMENTAL ASSESSMENT OF WASTEWATER TREATMENT PLANT SITE BY NET (JAN 1989).
3. TOTAL VOC CONCENTRATIONS FROM MARCH 2005 (ug/L) ARE LISTED BELOW WELLS WHERE ANALYZED.
4. STRATIGRAPHY FOR AW-2 FROM GEOPHYSICAL SURVEY COMPLETED BY GEOSPHERE, INC. (NOVEMBER 2005).

SCALE:
HORIZ. 1" = 80'
VERT. 1" = 20'

PROJECT: ASHLAND/NSP LAKEFRONT SITE
ASHLAND, WISCONSIN

TITLE: FIGURE 3-5
CROSS SECTION D-D'

DRAWN BY: DDZ	SCALE: AS SHOWN	PROJ. NO. 25688375
CHECKED BY: PJS	DATE: 30.JULY.2007	SHEET 3-5
APPROVED BY: DPT		

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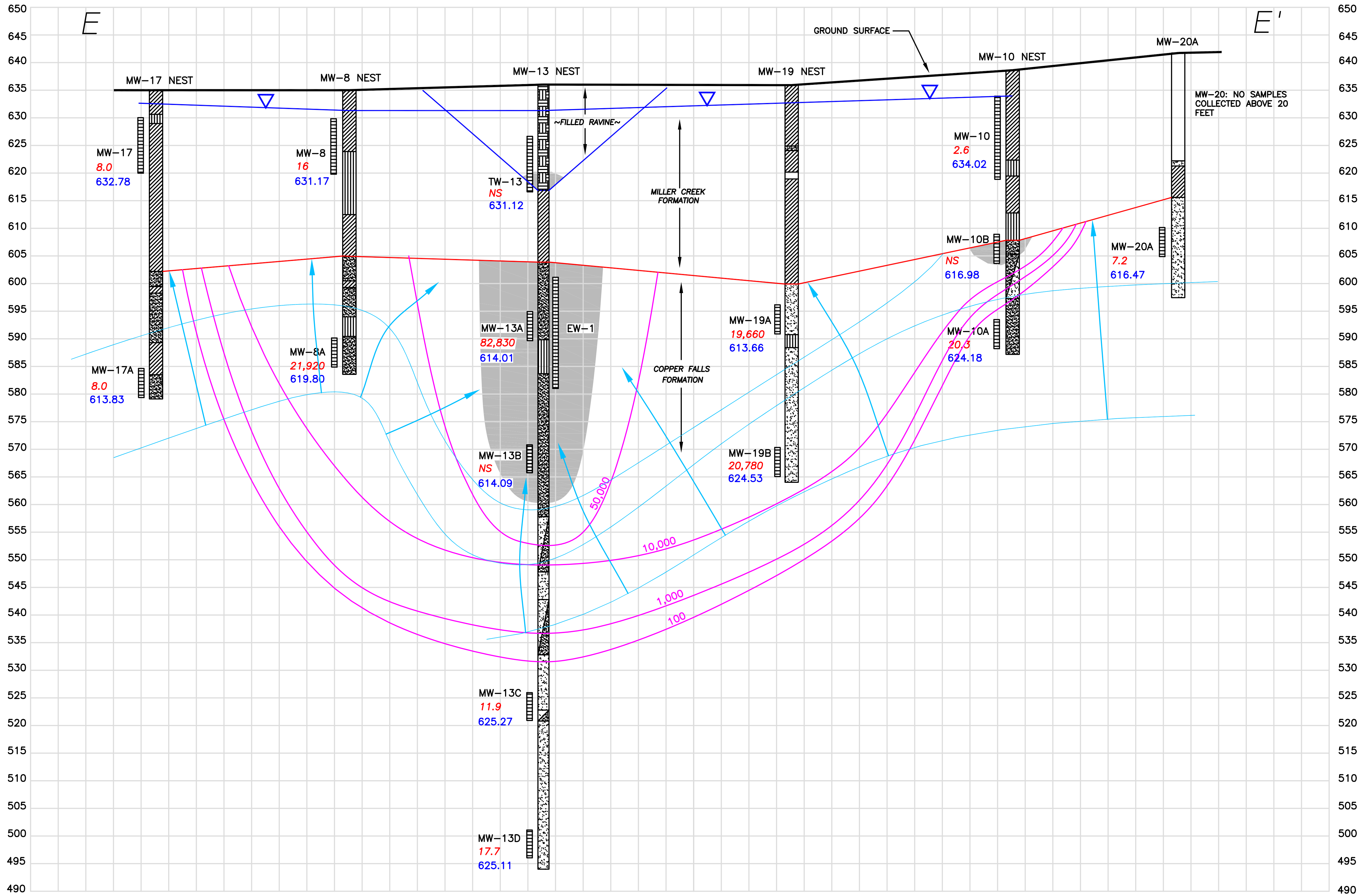
414-831-4100



LEGEND

- FILL SOILS
- WOOD WASTE FILL
- CLAY (CL, CH)
- SILT (ML)
- SILTY SAND (SM)
- CLEAN SAND (SP)
- GRAVELLY INTERVALS (GP, GM, GC, SW)
- BEDROCK
- DNAPL
- MONITORING WELL/PIEZOMETER SCREENED INTERVAL
- * ARTESIAN FLOW ENCOUNTERED
- TOTAL VOC CONCENTRATION (ug/L) SAMPLED IN MARCH 2005 (DASHED WHERE INFERRED, NS = NOT SAMPLED).
- BASE OF MILLER CREEK FORMATION
- 602.10 GROUNDWATER ELEVATION (MEASURED NOV. 3, 2005)
- WATER TABLE (MEASURED NOV. 3, 2005)
- EQUIPOTENTIAL SURFACE WITHIN COPPER FALLS FORMATION (MEASURED NOV. 3, 2005)
- GROUNDWATER FLOW DIRECTION

SCALE:
HORIZ. 1" = 80'
VERT. 1" = 20'

NOTES:

1. SOLID LINES INDICATE KNOWN STRATIGRAPHIC CONTACTS; DASHED LINES REPRESENT INFERRED CONTACTS.
2. TOTAL VOC CONCENTRATIONS FROM MARCH 2005 (ug/L) ARE LISTED BELOW WELLS WHERE ANALYZED.
3. GROUNDWATER ELEVATIONS FROM NOVEMBER 2005 (FT MSL) ARE LISTED BELOW WELLS WHERE MEASURED.

PROJECT: ASHLAND/NSP LAKEFRONT SITE ASHLAND, WISCONSIN		
TITLE: FIGURE 3-6 CROSS SECTION E-E'		
DRAWN BY: DDZ	SCALE: AS SHOWN	PROJ. NO. 25688375
CHECKED BY: PJS	DATE: 30.JULY.2007	SHEET 3-6
APPROVED BY: DPT		

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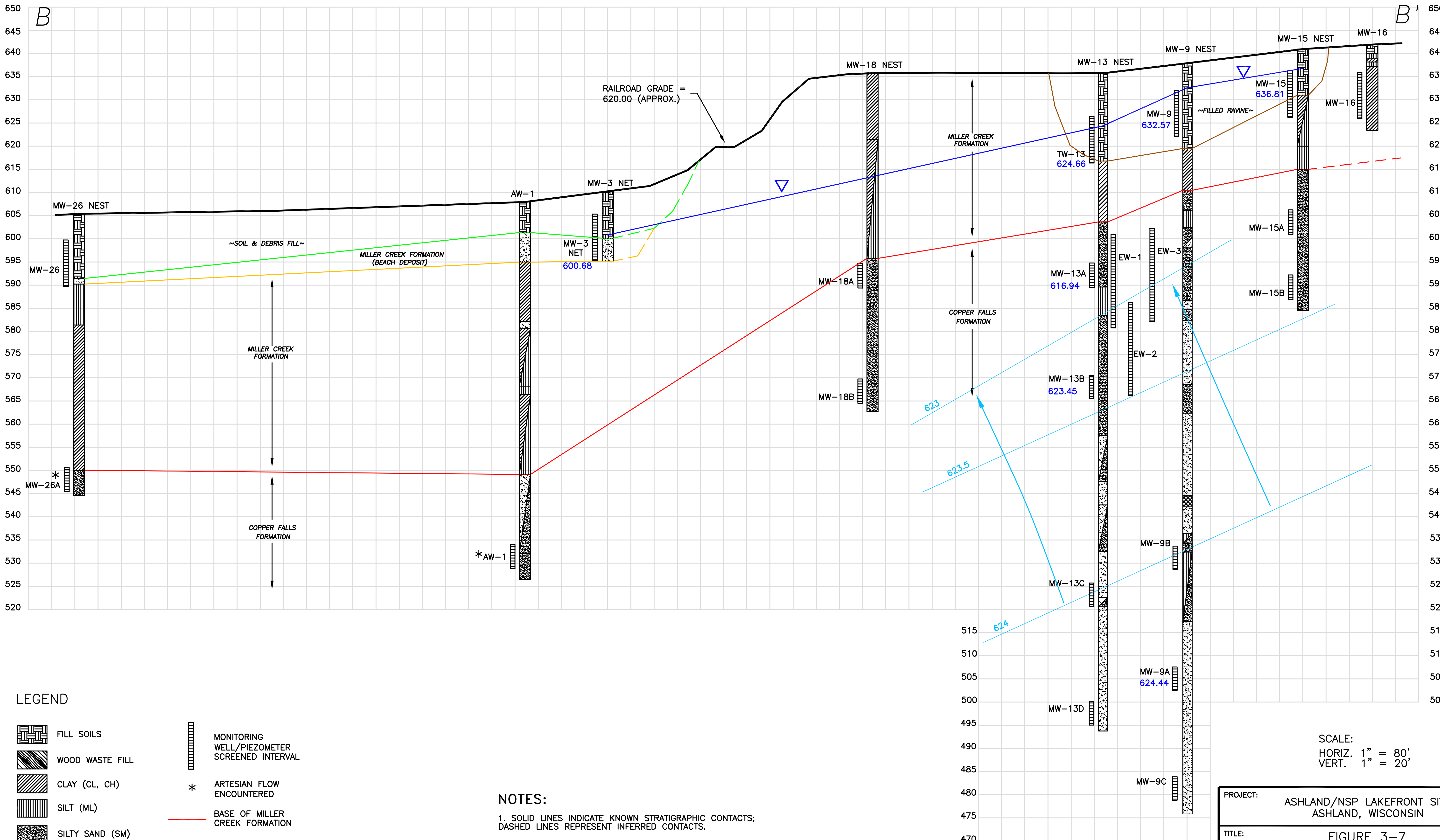
10200 INNOVATION DRIVE, SUITE 500
MILWAUKEE, WISCONSIN 53226
414-831-4100



LEGEND

- FILL SOILS
- WOOD WASTE FILL
- CLAY (CL, CH)
- SILT (ML)
- SILTY SAND (SM)
- CLEAN SAND (SP)
- GRAVELLY INTERVALS (GP, GM, GC, SW)
- BEDROCK
- MONITORING WELL/PIEZOMETER SCREENED INTERVAL
- * ARTESIAN FLOW ENCOUNTERED
- BASE OF MILLER CREEK FORMATION
- 602.10 GROUNDWATER ELEVATION (MEASURED JUNE 1999)
- ▽ WATER TABLE (MEASURED JUNE 1999)
- EQUIPOTENTIAL SURFACE WITHIN COPPER FALLS FORMATION (MEASURED JUNE 1999)
- GROUNDWATER FLOW DIRECTION

NOTES:

1. SOLID LINES INDICATE KNOWN STRATIGRAPHIC CONTACTS; DASHED LINES REPRESENT INFERRED CONTACTS.

2. STRATIGRAPHY FOR AW-1 FROM GEOPHYSICAL SURVEY COMPLETED BY GEOSPHERE, INC. (NOVEMBER 2005).

3. GROUNDWATER ELEVATIONS FROM JUNE 1999 (FT MSL) ARE LISTED BELOW WELLS WHERE MEASURED.

4. WELLS MW-9B, MW-9C, MW-13C, MW-13D, MW-15A, MW-15B, MW-16, MW-18A, MW-18B, MW-26, AND MW-26A WERE INSTALLED AFTER JUNE 1999.

PROJECT: ASHLAND/NSP LAKEFRONT SITE ASHLAND, WISCONSIN		
TITLE: FIGURE 3-7 CROSS SECTION B-B' PRIOR TO PUMPING – JUNE 1999		
DRAWN BY: DDZ	SCALE: AS SHOWN	PROJ. NO. 25688375
CHECKED BY: PJS	DATE: 30.JULY.2007	SHEET 3-7
APPROVED BY: DPT		

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10200 INNOVATION DRIVE, SUITE 500
MILWAUKEE, WISCONSIN 53226
414-831-4100

DRAFT

APPENDIX D – Basal Heave Sensitivity Analysis Results

Evaluation of Uplift Issue
Ashland, Wisconsin

Surface of Miller Creek (elev - ft)	Base of Miller Creek (elev - ft)	Thickness of Miller Creek (ft)	Unit Weight of Miller Creek (pcf)	Total Downward Pressure (psf)	Phreatic Surface Elevation (ft)	Total Head (ft)	Total Upward Pressure (psf)	Net Pressure (psf)	Factor of Safety	Remarks
590	567	23	130	2990	617.1	50.1	3126.2	-136.2	0.96	Conditions as presented by Foth 5/29/09 - "Base"
590	567	23	135	3105	617.1	50.1	3126.2	-21.2	0.99	Effect of varying unit weight of Miller Creek on "Base" conditions
590	567	23	125	2875	617.1	50.1	3126.2	-251.2	0.92	Effect of varying unit weight of Miller Creek on "Base" conditions
590	540	50	130	6500	617.1	77.1	4811.0	1689.0	1.35	Thickness of Miller Creek at MW-26 (URS section D-D' 7/30/07)
590	567	23	130	2990	617.1	50.1	3126.2	-136.2	0.96	Thickness of Miller Creek at boring 88-1 (URS section B-B' 7/30/07)
592	572	20	130	2600	617.1	45.1	2814.2	-214.2	0.92	Thickness of Miller Creek at boring 88-2 (URS section B-B' 7/30/07)
590	567	23	130	2990	617.1	50.1	3126.2	-136.2	0.96	Thickness of Miller Creek at MW-25 (URS section D-D' 7/30/07)
594	561	33	130	4290	617.1	56.1	3500.6	789.4	1.23	Thickness of Miller Creek at MW-24 (URS section D-D' 7/30/07)
590	540	50	130	6500	617.6	77.6	4842.2	1657.8	1.34	Variation in Phreatic Head at MW-26A; 6/05 thru 6/09 (5 readings)
590	540	50	130	6500	618.4	78.4	4892.2	1607.8	1.33	Variation in Phreatic Head at MW-26A; 6/05 thru 6/09 (5 readings)
590	567	23	130	2990	616.5	49.5	3088.8	-98.8	0.97	Variation in Phreatic Head at MW-25A; 6/05 thru 6/09 (5 readings)
590	567	23	130	2990	618.1	51.1	3188.6	-198.6	0.94	Variation in Phreatic Head at MW-25A; 6/05 thru 6/09 (5 readings)
594	561	33	130	4290	616.2	55.2	3444.5	845.5	1.25	Variation in Phreatic Head at MW-24A; 6/05 thru 6/09 (5 readings)
594	561	33	130	4290	616.8	55.8	3481.9	808.1	1.23	Variation in Phreatic Head at MW-24A; 6/05 thru 6/09 (5 readings)

APPENDIX E – Cost Estimates

Dry Dredge Hybrid of All Sediments > PRG

Total Sediment Volume:	109,000	Cys
Total Volume of Large Wood Waste:	26,781	Cys
Total Sediment Weight:	169,726	Tns

Construction Management		Unit	Quantity	Unit Cost	Total	Notes
1	Field Support	LS	1	3879040	$3,879,040	
2	Office Support	LS	1	1207536	$1,207,536	
3	Equipment Expense	LS	1	1243123	$1,243,123	
				Subtotal	**$6,329,699**	
Mechanical Dredging & Sediment Treatment						
Item Number	**Item**	**Unit**	**Quantity**	**Unit Cost**	**Total**	**Notes**
1	Mobe/ Demobe	LS	1	$1,919,032	$1,919,032	Move & Remove Labor, Equipment, Materials.
2	Site Preparation	LS	1	$1,378,097	$1,378,097	Install roads, processing area, Temp Building
3	Debris Removal -Wet	LS	1	$385,433	$385,433	Support Wet Dredging Operations
4	Install Cofferdams	LS	1	$25,188,347	$25,188,347	Includes east & west wing walls
5	Backfill Cofferdams	LS	1	$4,464,386	$4,464,386	Place materials in Cofferdam
6	Dry Excavation	Tns	112,019	$71	$7,990,315	Mechanical removal and infrastructure
7	Dredging Wet	Tns	57,707	$14	$829,250	Outside of the cofferdam
8	Wood Removal& Processing -Dry	LS	1	$1,112,156	$1,112,156	Removal and chipping wood
9	Stabilization of Sediments	Tns	183,304	$27	$4,896,050	Stabilize sediments for offsite disposal
10	Sand Cover Wet	Cys	5,196	$130	$673,194	Place 6" over dredge area
11	Cofferdam Removal	LS	1	$2,910,370	$2,910,370	Remove structure
12	Backfill Dry Dredge	Cys	10,086	$84	$847,930	Place 6" in the dry post dredging
13	Work Under Dam	LS	1	$850,340	$850,340	Wet Removal Pre-Cofferdam installation
14	Wave Attenuation	LS	1	$1,540,476	$1,540,476	Temporary System
15	Sprung Building	LS	1	$970,012	$970,012	138' x 200' w/ Air Handling System
16	Odor Control	LS	1	$544,092	$544,092	Maintain continuous odor control measures
17	Backfill Under Cofferdams	LS	1	$1,410,669	$1,410,669	Sand for final cover
18	Containment System	LS	1	$188,151	$188,151	Silt curtains
				Subtotal	**$58,098,299**	
Air Monitoring		**Unit**	**Quantity**	**Unit Cost**	**Total**	**Notes**
1	Real Time & 24 hr	LS	1	$1,326,000	$1,326,000	Analytical Included; 24/7 for 14 months
				Subtotal	**$1,326,000**	
Transport & Disposal						
Item Number		**Unit**	**Quantity**	**Unit Cost**	**Total**	**Notes**
1	Loading for Offsite Disposal	Tns	183304	4.32	$791,873	Load & Decon Trucks
2	Transportation & Disposal	Tns	183304	31.88	$5,843,732	Sediment Non Haz Landfill- Wood to Burner
3						
				Subtotal	**$6,635,605**	
Water Treatment						
Item Number		**Unit**	**Quantity**	**Unit Cost**	**Total**	**Notes**
1	Waste Water Treatment	Days	105	4960	$520,800	Assume discharge to POTW
				Subtotal	**$520,800**	
Misc:						
Item Number		**Unit**	**Quantity**	**Unit Cost**	**Total**	**Notes**
1	Surveying	LS	1	$55,000	$55,000	
2	Drilling	LS	1	$22,000	$22,000	
3	Laboratory	LS	1	$80,437	$80,437	
				Subtotal	**$157,437**	
Post Construction:						
Item Number		**Unit**	**Quantity**	**Unit Cost**	**Total**	**Notes**
1	Closure Report	LS	1	$203,000	$203,000	
				Subtotal	**$203,000**	
				Task Grand total	**$73,270,840**	

Mechanical Dredging of All Sediments > PRG

Total Sediment Volume:	109,000	Cys
Total Volume of Large Wood Waste:	26,781	Cys
Total Sediment Weight:	169,726	Tns

Construction Management		**Unit**	**Quantity**	**Unit Cost**	**Total**	**Notes**
1	Field Support	1	1	$2,113,120	$2,113,120	31 wks of support for 24hr operation
2	Office Support	1	1	$603,800	$603,800	Evaluation and QC
3	Equipment/Expense	1	1	$714,300	$714,300	
				Subtotal	**$3,431,220**	
Mechanical Dredging & Sediment Treatment						
Item Number	**Item**	**Unit**	**Quantity**	**Unit Cost**	**Total**	**Notes**
1	Mobe/ Demobe	1	1	$2,036,563	$2,036,563	Move & Remove Labor, Equipment, Materials.
2	Process Area	LS	1	$456,348	$456,348	
3	Site maintenance	LS	1	$135,380	$135,380	
4	Sediment Removal	Tns	147,150	$18.30	$2,692,845	
5	Wood Removal & off loading	Tns	36,154	$108	$3,905,717	Removal and chipping wood
6	Debris removal	LS	1	$1,393,878	$1,393,878	Support Wet Dredging Operations
7	Containment System	LS	1	$696,939	$696,939	Silt curtains
8	Stabilization of Sediments	Tns	13,578	$462	$6,272,357	Stabilize sediments for offsite disposal
9	Sand Cover	Cys	15,282	$213	$3,254,455	Place 6" over dredge area
10	Wave Attenuation	LS	1	$1,540,476	$1,540,476	Temporary System
11	Sprung Building	LS	1	$970,013	$970,013	138' x 200' w/ Air Handling System
12	Odor Control	LS	1	$229,811	$229,811	Maintain continuous odor control measures
				Subtotal	**$23,584,781**	
Air Monitoring		**Unit**	**Quantity**	**Unit Cost**	**Total**	**Notes**
1	Real time & 24 hr	1	1	$626,000	$626,000	Analytical included, 24/7 for 7 months
				Subtotal	**$626,000**	
Transport & Disposal						
Item Number		**Unit**	**Quantity**	**Unit Cost**	**Total**	**Notes**
1	Loading for offsite disposal	Tns	183,304	4.32	$791,873	
2	Offsite Trans & dispose	Tns	183,304	31.88	$5,843,732	
				Subtotal	**$6,635,605**	
Water Treatment						
Item Number		**Unit**	**Quantity**	**Unit Cost**	**Total**	**Notes**
1	WW Treatment	Days	105	$4,960	$520,800	
				Subtotal	**$520,800**	
Misc:						
Item Number		**Unit**	**Quantity**	**Unit Cost**	**Total**	**Notes**
1	Surveying	1	1	$55,000	$55,000	project bathymetry
2	Drilling	1	1	$22,000	$22,000	Additional Geotech work
3	Laboratory	1	1	$80,437	$80,437	Floor Samples
				Subtotal	**$157,437**	
Post Construction:						
Item Number		**Unit**	**Quantity**	**Unit Cost**	**Total**	**Notes**
1	Closure Report	1	1	$203,000	$203,000	
2					$0	
3					$0	
				Subtotal	**$203,000**	
				Task Grand Total	**$35,158,843**	